Range Mgmt. & Agroforestry 41 (2) : 267-275, 2020
ISSN 0971-2070

Effect of agri-silvi-horticultural system on soil chemical properties and available nutrients at different depths in Haryana

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Received: 3[rd], April, 2020 Accepted: 11[th] November, 2020

Abstract

The present investigation was carried out at Research Farm, Department of Forestry, CCS Haryana Agricultural University, Hisar during 2017-18 to evaluate the effect of agri-silvi-horticultural system on soil chemical properties and available nutrients at different depths. Soil samples from different tree based systems (kinnow + eucalyptus + wheat and kinnow + wheat) and control (devoid of tree) were taken at 0-15, 15-30, 30-60 and 60-90 cm depths. Soil pH and electrical conductivity reduced significantly under kinnow + eucalyptus + wheat system by 1.5% and 25%, respectively over control. The kinnow + eucalyptus + wheat system showed higher organic carbon content and available nutrients (N, P and K) than sole cropping at different depths. The highest soil organic carbon (0.40%) was observed under kinnow + eucalyptus + wheat system followed by kinnow + wheat (0.37%) and it was lowest in system without trees (0.27%). Soil organic carbon and nutrient content decreased with increase in depth irrespective of tree species. Significant increment in available nitrogen was observed under kinnow + eucalyptus + wheat system by 47.9% and under kinnow + wheat system by 33.7% over control. The available N, P, and K content was higher under kinnow + eucalyptus + wheat system (113.9, 11.5 and 225.3 kg/ha, respectively) followed by kinnow + wheat system (103.8, 10.2 and 213.0 kg/ha, respectively) over control (77.0, 8.7 and 198.6 kg/ha, respectively). Different tree based system and depth significantly affected the DTPA extractable micronutrients (Zn, Mn, Cu and Fe) contents in soil. All chemical properties except pH and calcium carbonate were significantly correlated with each other. Hence tree based systems enhanced soil organic matter content, available nutrients and improved soil properties.

Keywords: Agri-silvi-horticulture, Available nutrients, *Eucalyptus*, Kinnow, Soil properties

Introduction

Multipurpose trees are of great significance as they not only provide numerous products (timber, fuel wood, fruits, fodder, fibers etc), but also perform soil amelioration functions. They provide a huge amount of organic matter to soil in the form of leaves, twigs, stem and flower which becomes organic matter and release different essential nutrients after decomposition (Rahangdale *et al.*, 2014). Litter fall and fine root biomass are important vectors of nutrient recycling in tree based ecosystems (Gill and Jackson, 2000; Sayer, 2006). The fine roots system of the trees plays crucial role in the fluxes of energy and matter in the biosphere and carries out the essential function of soil resource acquisition (Stewart and Frank, 2008). Roots provide detritus carbon to heterotrophic soil organisms and are important factors influencing the effectiveness of riparian buffer in immobilizing and processing soil water pollutants thereby influencing soil quality. Therefore, the soil quality and its production capacity can be restored and improved by adopting agroforestry system like agri-silvi-horticultural system, which provides a way to sustain agricultural productions (Thakur and Kumar, 2006).

Agri-silvi-horticultural systems particularly eucalyptus and kinnow based agroforestry system can be planted with different cropping sequence, particularly on poor soils. These systems emerged as an option for crop diversification in north-west India by enhancing productivity, net profitability and mitigating climate change (Chaudhari *et al.*, 2014). Eucalyptus trees strengthen economic security during crop failure and on the other hand kinnow provides good return through fruit yield. Eucalyptus has also real potential as supplementary fodder due to its rapid growth and ability to withstand periodic drought. Elliot and Jones (1993) reported that foliage of *Eucalyptus aggregata* can be used as fodder, while eucalyptus leaf meal powder has been used as rumen enhancer in cattle reducing methane emission without affecting the nutrient digestibility (Manh *et al*., 2012). Therefore, this agri-silvi-horticultural system is a continuous income generating system which not only helps the farmers in assured income in the events of weather vagaries but also protects the land from degradation and enhances the soil quality. But eucalyptus and kinnow affect the yield and nutrient uptake of intercrop due to their shade effect and competition for moisture and nutrients besides improving soil health through addition of organic matter by litter fall. Keeping this in view, the present study was carried out to evaluate the effect of agri-silvi-horticultural system on chemical properties and available nutrients at different soil depths.

Materials and Methods

Experimental details: Present study was carried out at Research Farm, Department of Forestry, Chaudhary Charan Singh Haryana Agricultural University, Hisar during 2017-18. The experimental site is located at 29º09' N latitude and 75º 43' E longitude at an elevation of 215 meters above mean sea level which comes under semi-arid region of north-west India. The average annual rainfall is 350-400 mm and climate is sub-tropical. Depth wise soil samples were collected from 4 depths (0-15, 15-30, 30-60 and 60-90 cm) after harvesting of wheat from different land use system (sole wheat, kinnow + wheat and kinnow + eucalyptus + wheat).

Details of treatments: Under agri-silvi-horticulture system, plants of clonal eucalyptus (HC-2045) were planted at a spacing of 6 × 6 m and in-between two eucalyptus plants, one kinnow plant (virus free) was established during September, 2011. In agri-horticultural system, kinnow plants were planted at the spacing of 6 x 6 m at same time. Wheat crop was taken in association with kinnow and eucalyptus trees. In the adjacent field wheat crop was grown and considered as control or sole crop. In this experiment, the recommended packages of practices were followed separately for the eucalyptus, kinnow and intercrops. Besides natural incorporation of the foliage, the remaining biomass of the intercrops was incorporated after harvest in the respective treatments. Recommended dose of fertilizer (RDF) *i.e.* 150 kg N + 60 kg P_2O_5 + 30 kg K_2O + 25 kg $ZnSO_4$ per hectare was applied in each treatment. The whole amount of P and K and half dose of N were applied at the time of sowing. The remaining N through urea was top dressed at crown root initiation stage. Under trees 8 kg FYM was incorporated around each tree every year in the rainy season (June-July). In addition to these under trees RDF + 10% additional dose of N was applied. At the time of initiation of experiment (September 2011), the soil (0-15 cm depth) had EC- 0.55 dS/m, pH-8.12, organic carbon-0.38%, available nitrogen-110.6 kg/ha, available phosphorus-10.2 kg/ha, available potassium-226 kg/ha, calcium carbonate-0.79%, Zn- 0.96 mg/kg, Fe -5.4 mg/kg, Cu-0.38 mg/kg and Mn -7.2 mg/kg.

Soil chemical analysis: The collected soil samples were dried in open air and then crushed with the help of mortar and pestle after that it was sieved using a 2 mm stainless steel sieve and then stored in polythene bags. The soil samples were analyzed for chemical properties (pH, electrical conductivity, calcium carbonate and organic carbon) and available nutrients (nitrogen, phosphorus, potassium, and DTPA extractable micronutrients). The soil pH and EC was determined in 1:2 soil-water suspensions (Jackson, 1973), while calcium carbonate was determined by titration method (Puri, 1931). Organic carbon was determined by chromic acid titration method (Walkley and Black, 1934). The available N in the soil samples was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956), available phosphorus was determined using Olsen's method (Olsen *et al*., 1954) and available potassium was determined using neutral normal ammonium acetate method (Jackson, 1973). Available micronutrients were extracted with DTPA extractant (Lindsay and Norvell, 1978) and estimated on an atomic absorption spectro-photometer.

Statistical analysis: Statistical methods proposed by Panse and Sukhatme (1989) were followed to analyze the soil properties and available soil nutrients. Analysis of variance technique was used to analyze the data statistically in order to find the significance effect of treatments (Fisher, 1950). 'F' test at 5% level of significance was employed to relate the significant difference among the means of two treatment effects.

Results and Discussion

Soil pH, electrical conductivity and calcium carbonate: Effect of tree based system and soil depth was significant on soil pH and electrical conductivity whereas their interaction was found non-significant. The influence of system, soil depth and their interaction on soil calcium carbonate was found non-significant. The average soil pH ranged from 8.15 to 8.28 under various tree based system. There was 1.5% reduction in soil pH under kinnow + eucalyptus + wheat system followed by 0.3% under kinnow + wheat system over control. Significant increase in soil pH with increase in depth was observed.

Table 1. Effect of agri-silvi-horticultural system on soil pH, EC (dS/m) and calcium carbonate (%) at different depth

System	Soil pH					Soil EC (dS/m)					Calcium carbonate (%)				
	Depth (cm)					Depth (cm)					Depth (cm)				
	0-15	**15-30**	**30-60**	**60-90**	**Mean**	**0-15**	**15-30**	**30-60**	**60-90**	**Mean**	**0-15**	**15-30**	**30-60**	**60-90**	**Mean**
Control	8.13	8.30	8.32	8.37	8.28	0.65	0.42	0.38	0.33	0.44	0.76	0.82	0.92	0.99	0.87
Kinnow + wheat	8.02	8.23	8.36	8.40	8.25	0.57	0.35	0.30	0.26	0.37	0.71	0.81	0.87	0.96	0.83
Kinnow + eucalyptus + wheat	7.95	8.09	8.37	8.30	8.15	0.50	0.31	0.28	0.24	0.33	0.69	0.87	0.90	0.95	0.85
Mean	8.00	8.21	8.35	8.36		0.57	0.36	0.32	0.27		0.72	0.83	0.89	0.97	
LSD (P=0.05)	System (S): 0.10 Depth (D): 0.12 S × D: NS					System (S): 0.02 Depth (D): 0.03 S × D: NS					System (S): NS Depth (D): NS S × D: NS				

Similarly, the electrical conductivity of soil was significantly reduced under tree based system by 25% and 15.9% under kinnow + eucalyptus + wheat system and kinnow + wheat system respectively over control (Table 1). Soil EC was found decreased with increase in soil depth. Calcium carbonate content in soil varied from 0.69% under agri-silvi-horticultural system at 0-15 cm soil depth to 0.99% under control at 60-90 cm depth. However, soil calcium carbonate did not differ significantly under different treatment combinations (Table 1).

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. These findings corroborate with the results of Gupta and Sharma (2009) and also with Newaj *et al.* (2007) who observed little changes in soil pH under agroforestry system. Dalal *et al.* (2015) during an experiment observed lesser electrical conductivity (0.14-0.18 dS/m) and pH under agri-silvi-horticulture system than sole crops (0.22-0.26 dS/m). They also observed decrease in electrical conductivity and pH with increase in depths.

Soil organic carbon: The kinnow + eucalyptus + wheat system showed higher amount of organic carbon and available nutrients (N, P and K) than sole cropping at different depths (Table 2). Available N, P, K also behaved like organic carbon since their availability depends upon amount of organic matter present in the soil.

Indeed, soil organic carbon was significantly influenced by tree based system, soil depths and their interaction. The soil organic carbon (SOC) content was higher in the surface soils (0-15 cm) and gradually declines with the depth (Table 2). The highest soil organic carbon (0.40%) was observed under kinnow + eucalyptus + wheat system followed by kinnow + wheat (0.37%) and it was lowest in wheat system (0.27%). Amongst different soil depths, the average organic carbon concentration was the highest in surface soil depth (0.53%) and the lowest in 60-90 cm depth (0.13%). In surface and subsurface soil depth, the organic carbon was increased by 40.9% and 44.1%, respectively under kinnow + eucalyptus + wheat system followed by kinnow + wheat (25% and 29.4%, respectively) over control (0.44% and 0.34%, respectively). Similarly, the increase in organic carbon content in 30-60 cm and 60-90 cm soil depth was highest (90% and 27.0%, respectively) under kinnow + eucalyptus + wheat followed by kinnow + wheat (85% and 27.0%, respectively) over control (0.31% and 0.13%, respectively).

Table 2. Effect of agri-silvi-horticultural system on organic carbon (%) and available nutrients at different depth

System	Organic carbon (%)					Available nitrogen (kg/ha)				
	Depth (cm)					Depth (cm)				
	0-15	15-30	30-60	60-90	Mean	0-15	15-30	30-60	60-90	Mean
Control	0.44	0.34	0.20	0.11	0.27	117.7	92.60	59.80	37.8	77.00
Kinnow + wheat	0.55	0.44	0.37	0.14	0.37	147.4	120.1	101.2	46.6	103.8
Kinnow + eucalyptus + wheat	0.62	0.49	0.38	0.14	0.40	168.5	134.4	105.7	47.1	113.9
Mean	0.53	0.42	0.31	0.13		144.5	115.7	88.90	43.8	
LSD (P=0.05)	System (S): 0.02 Depth (D): 0.03 S × D: 0.05					System (S): 7.6 Depth (D): 8.8 S × D: 15.2				

System	Available phosphorus (kg/ha)					Available potassium (kg/ha)				
	Depth (cm)					Depth (cm)				
	0-15	15-30	30-60	60-90	Mean	0-15	15-30	30-60	60-90	Mean
Control	13.1	9.60	7.3	4.8	8.70	270.5	223.3	177.5	123.3	198.6
Kinnow + wheat	16.7	11.7	7.4	5.1	10.2	292.5	251.1	183.0	125.4	213.0
Kinnow + eucalyptus + wheat	18.2	12.4	9.5	5.9	11.5	306.5	250.3	201.0	143.7	225.3
Mean	16.0	11.2	8.1	5.2		289.8	241.5	187.1	130.8	
LSD (P=0.05)	System (S): 1.5 Depth (D): 1.7 S × D: NS					System (S): 6.9 Depth (D): 8.0 S × D: NS				

The soil enrichment in organic carbon under tree based systems could be due to several factors such as addition of litter; annual fine root biomass recycled and root exudates and its reduced oxidation of organic matter under tree shades (Gill and Burman, 2002). Moreover, the mineralization of organic matter releases nutrient into the soil (Osman *et al*., 2001). These findings were also supported by earlier workers (Gupta and Sharma, 2009; Das and Chaturvedi, 2005; Yadav *et al.,* 2008). On account of recycling of organic matter, higher organic carbon and available N, P and K contents were observed in the soil under intercropped trees plantations than at a site devoid of trees (Singh *et al*., 1989; Moshin *et al*., 1996). Kumar *et al.* (2017) reported increase in organic carbon from 0.12 % to 0.27% under tree component as compared to field without tree plantation. Kaushal *et al.* (2016) also reported increase in organic carbon by 13 to 46% in different grewia based agroforestry systems as compared to fallow plot. Palsaniya *et al.* (2009) found that wherever shisham and subabul were introduced with crops, the organic carbon content increased significantly over treatments of pure crop and trees alone. The organic carbon status in subabul + maize treatment was 0.72%. In shisham + maize, it was 0.61%, while in crop alone it was 0.48% only. Similarly Saha *et al.* (2014) also observed highest increase in organic carbon content (by 25%) under gamhar + mango + pigeon pea agri-silvi-horticultural system (from 0.36 to 0.45%) than sole gamhar agroforestry model which recorded only 3.7% increase.

Available nitrogen: The different depths of soil in agroforestry systems had significantly higher available nitrogen as compared to sole cropping (77.0 kg/ha). Significant increase in available nitrogen was observed by 47.9% and 33.7% under kinnow + eucalyptus + wheat system and kinnow + wheat system, respectively over control (Table 2). Available nitrogen was also found significantly higher (144.5 kg/ha) at surface (0-15 cm) as compared to deep soil layers. The increase in available N under tree component systems was more in 0-15 cm soil depth than the lower depths. The N content in different treatments in 0-15 and 15- 30 cm soil layers varied from 35.4 to 38.0% and 28.9 to 30.0%, respectively of the N content in 0-90 cm soil profile indicating higher N content in these layers as compared to lower layers (Table 2). The N content in 0-90 cm soil profile was higher under kinnow + eucalyptus + wheat system by 48% followed by kinnow + wheat (by 34.8%) over control.

A significant increase in these parameters indicated that there was more buildup of organic matter, which acts as labile pool of nutrients for soil micro flora and plants or crops, which was also indicated by the increase in amount of available N and P. The impact of agroforestry systems on soil fertility in terms of higher organic matter content, total nitrogen in the top soil was also reported earlier (Rizvi *et al*., 2011; Kaushal *et al*., 2016). Similarly, Saha *et al.* (2014) recorded highest increase in available N (26.7%) after harvest under gamhar + mango + pigeon pea agroforestry model. Dalal *et al*. (2015) observed highest available N at top soil in guava + khejri + wheat agroforestry model whereas minimum was found in sole cropping systems and decreased with increase in soil depth.

Available phosphorus: Among the two trees based system, average available P concentration was higher by 32.1% under kinnow + eucalyptus + wheat system followed by 17.2% under kinnow + wheat system over control (8.7 kg/ha). The P content was higher in the surface soil as compared to sub-surface layer. The P content in soil profile (0-90 cm) depth revealed significantly higher values under kinnow + eucalyptus + wheat and kinnow + wheat system as compared to sole cropping system (control). Out of this, 39.5% and 40.8% phosphorus content was present in the surface soil depth under kinnow + eucalyptus + wheat and kinnow + wheat system, respectively (Table 2).

Significant influence of tree based system and soil depth for soil available phosphorus might be attributed to higher acidic phosphatase activity, as the organic anion exudation and acid phosphatase activity of tree roots was found to increase mobilization of P in the rhizosphere (Cadwell, 2005). The decreased availability of P with each successive increase in soil depth was in conformity with the earlier findings (Swamy *et al*., 2008; Majumdar *et al*., 2004; Ghimire, 2010). Available P was found to increase from 9.70 to 13.36 kg/ha under tree species over field without tree plantation as observed by Kumar *et al.* (2017). Similarly, Kaushal *et al.* (2016) reported increase in available P in different grewia based agroforestry systems as compared to fallow plot. Singh *et al.* (2018) evaluated available P under agroforestry systems such as agri-silvi-horticulture, agri-horticulture, agri-silviculture, silvi-pastoral and found significant higher values of available P over sole agriculture land use system. Kaushik *et al.* (2017) observed higher P content at surface soil than subsurface. Also highest P (18.5 kg/ha) was recorded under khejri + guava + clusterbean-barley than sole cropping system. Dhara and Sharma (2015) reported highest increase in available P under eucalyptus + mango + pigeon pea and eucalyptus + mango + black gram, and the soil available P was increased by 35.6% and 27.7%, respectively from its initial value.

Available potassium: The available K content under tree based system was significantly higher than control (Table 2). The mean available K content was higher under kinnow + eucalyptus + wheat system (225.3 kg/ha) followed by kinnow + wheat system (213.0 kg/ha) and lowest in control (198.6 kg/ha). Similarly increase in available K content in all soil depths varied by 13.4% (kinnow + eucalyptus + wheat) to 7.2% (kinnow + wheat) over control. More than 60% (except control) of K was present in the upper two soil depths. Improvement in available potassium was a consequence of higher litter fall and fine root turnover at surface layer (Bhardwaj *et al*., 2001; Swamy *et al*., 2008; Kaushal *et al*., 2016). Mishra and Swamy (2007) and Kumar *et al.* (2017) also observed increase in available K (336 to 393 kg/ha) under tree species compared to field without plantation. Dhara and Sharma (2015) evaluated soil K status after two cropping cycles at West Bengal and found increased K by 18.0% and 13.3% under eucalyptus + mango + pigeon pea and eucalyptus + mango + black gram systems, respectively from its initial value. Banerjee and Dhara (2011) also studied available K content under different agri-horti-silvicultural models in West Bengal. They observed highest increased values of K_2O (170.5 kg/ha) in *A. auriculiformis* + sweet orange + groundnut based land use system over its initial values of 132.5 kg/ha K_2O.

***DTPA extractable micronutrients (Zn, Mn, Cu and Fe)*:** Different tree based system and soil depth significantly affected the DTPA extractable micronutrients (Zn, Mn, Cu and Fe) contents in soil (Fig 1-4). Interaction between system and soil depth was found significant for all micronutrients except for Fe. Significantly highest micronutrient contents recorded in kinnow + eucalyptus + wheat system at surface soil (0-15 cm) and it decreased with increase in depth. Indeed, the DTPA-extractable micronutrients decreased significantly with increase in depth. All the micronutrients were higher under the tree based system as compared to control mainly in the surface soil layer (0-15 cm) and their concentrations were the lowest in the lower soil depths (30-60 and 60-90 cm) than the upper depths. Available Zn in the surface layer was highest in kinnow + eucalyptus + wheat (2.06 mg/kg) and the lowest in control (1.12 mg/kg) among the different systems. About 77.5% of Zn content under kinnow + eucalyptus + wheat system and 76.9% of Zn content under kinnow + wheat system was in the upper two soil depths. The Zn content in the profile was also significantly higher under tree based system *i.e.* kinnow + eucalyptus + wheat system (69.4%) and kinnow + wheat system (48.2%) than control (2.9 mg/kg). Similarly, the available Fe content was higher in surface soil depth than the lower depths and varied from 6.0 mg/kg under kinnow + wheat system to 7.3 mg/kg under kinnow + eucalyptus + wheat system among tree species, which was significantly higher than the control (5.4 mg/kg). In 0-90 cm soil profile, its accumulation was higher by 20.5% and 40.5% under kinnow + eucalyptus + wheat and kinnow + wheat system, respectively over control (18.0 mg/kg). The Fe content in surface soil layer varied from 27.7 to 29.7% of its content in the whole soil profile studied. The available Mn content in the surface soil depth varied from 8.8 mg/kg in control to 12.1 mg/kg under kinnow + eucalyptus + wheat system. The available Cu was the highest under kinnow + eucalyptus + wheat in surface (0.64 mg/kg) and in 0-90 cm soil profile (1.9 mg/kg) which was significantly higher than control.

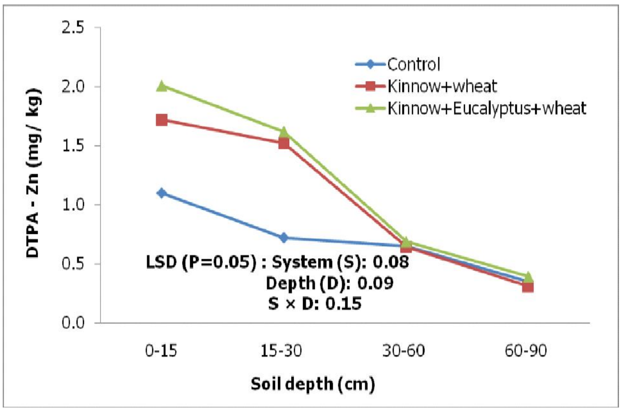

Fig 1. Effect of agri-silvi-horticultural system on DTPA extractable Zn in soil at different depths

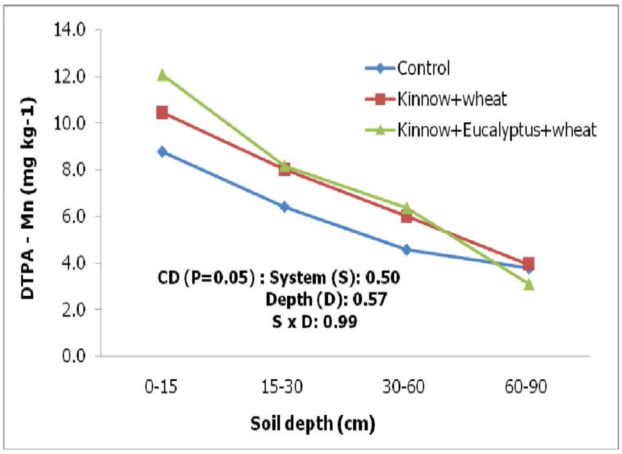

Fig 2. Effect of agri-silvi-horticultural system on DTPA extractable Mn in soil at different depths

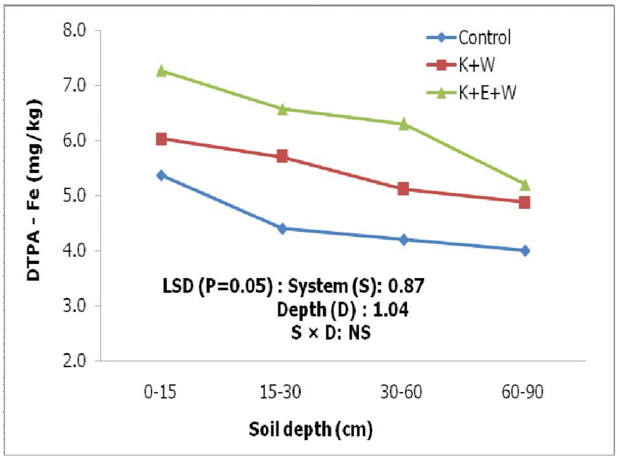

Fig 3. Effect of agri-silvi-horticultural system on DTPA extractable Fe in soil at different depths

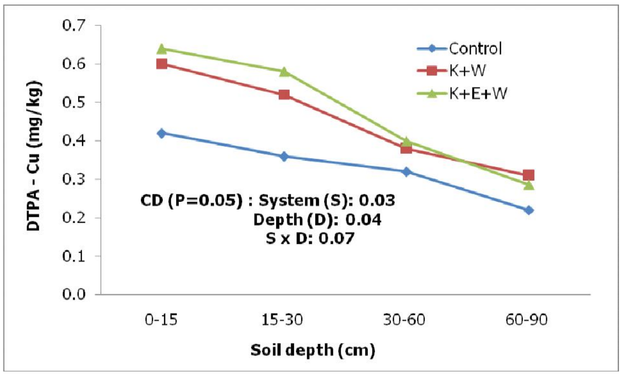

Fig 4. Effect of agri-silvi-horticultural system on DTPA extractable Cu in soil at different depths

The higher amount of DTPA extractable micronutrients at surface layer was probably due to more organic matter content. Secondly the trees extract nutrients from deeper soil profile and addition to top soil layer through litter fall and fine root biomass. Nutrient cycling is considered as the leading factor, and anthropogenic disturbance and leaching were the secondary factors that affect the vertical distributions and topsoil accumulation of nutrients under different land use systems (Jobbage and Jackson, 2001). Campanha *et al*. (2007) reported higher Cu under agroforestry system than monoculture. Singh and Sharma (2007) observed increase in Cu content under agroforestry system with increase in age. The DTPA extractable- Cu in soil decreased significantly with each successive soil depth *i.e*. from 0-15 cm to 60-90 cm, and maximum and significantly higher Cu content was observed in 0-15 cm soil depth than other soil layers. Jiang *et al*. (2009) also reported that the DTPA extractable-Mn decreased significantly with each successive increase in soil depth. The content of Fe, Mn, Zn and Cu was higher by 15, 31, 101 and 86%, respectively under the tree species than the field without plantation (Kumar *et al*., 2017). This could be explained by the quantity of litter production by trees and its chemical composition. Khanmirzaei *et al*. (2011) reported significant increase in soil available micro-nutrients especially Fe and Mn contents at 0-20 cm soil depth. These increased from 1.85 to 3.6 mg/kg and 2.10 to 11.3 mg/kg for Fe and Mn, respectively. Increased concentrations of Fe and Mn in soil under short rotation *Eucalyptus* spp. plantations were reported from Kenya (Oballa *et al*., 2010).

Correlation coefficient among different parameters: Correlation coefficient among different soil properties and available nutrients under different tree based system were recorded (Table 3). Significant positive correlation was found among soil chemical properties except calc-

Table 3. Correlation coefficient among various soil properties and available nutrients under different tree based system

Variables	pH	EC	$CaCO_3$	OC	N	P	K	Zn	Mn	Cu	Fe
pH	1										
EC	-0.071	1									
$CaCO_3$	0.261	-0.785	1								
OC	-0.134	.620**	-.887**	1							
N	-0.143	.607**	-.870**	.998**	1						
P	-0.176	.753**	-.876**	.925**	.934**	1					
K	-0.168	.721**	-.942**	.940**	.927**	.876**	1				
Zn	-0.141	.585**	-.837**	.928**	.930**	.914**	.912**	1			
Mn	-0.14	.715**	-.911**	.965**	.968**	.964**	.933**	.944**	1		
Cu	-0.133	.460**	-.701**	.862**	.872**	.839**	.817**	.928**	.850**	1	
Fe	-0.114	.294*	-.507**	.765**	.796**	.740**	.609**	.754**	.788**	.727**	1

*(P<0.05); **(P<0.01)

-ium carbonate, and pH showed negative correlation with other soil chemical properties. Positive correlation was also observed between EC and other chemical properties except with calcium carbonate.

Conclusion

The study indicated that kinnow + eucalyptus + wheat system had higher potential of accumulating organic carbon in the soil than other systems. Combination of kinnow and eucalyptus tree species seems to improve the status of macro and micronutrients more than kinnow alone, probably due to more and faster decomposition of litter fall. Hence, kinnow and eucalyptus based agri-silvi-horticulture system can be adopted in large scale to improve soil fertility status.

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