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Effect of organic manures on soil physico-chemical properties of *Ocimum sanctum* under stone fruit based agroforestry system

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Abstract
The study was conducted for two consecutive years during 2016 and 2017 at experimental farm of Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (HP) to evaluate the effect of different organic manures and their distance of application from tree trunk on soil physico-chemical properties under Peach and Apricot based agroforestry system. The experiment was laid out in randomized block design (factorial) consisting of seven treatments with three distance levels. The results revealed that among different organic manure treatments, FYM @ 25 t ha^{-1} significantly influenced the soil physico-chemical properties of *Ocimum sanctum* and recorded highest soil moisture (11.20% and 11.27%), electrical conductivity (0.29 and 0.29), organic carbon (2.35% and 2.12%), available nitrogen (354.97 and 255.42), available phosphorus (55.08 and 53.88) and available potassium (356.40 and 278.96) over control when applied at a distance of 1m away from tree trunk under peach and apricot based agroforestry system, respectively.

Keywords: Jeevamrut, *Ocimum sanctum,* peach, soil physico-chemical properties

Introduction

Soil health is a continuous potential of soil to function as a living system, which sustain biological productivity, environmental quality as well as plant & animal health (Karlen *et al.*, 1997; Oliver *et al*,. 2013) [1, 2]. Sustainable agriculture production depends on the scientific management of soil health to meet people's present and future needs. But now days, the health of soil facing high degradation problems due to increased pressure of human and livestock population on inadequate natural resources. Unscientific agricultural practices, deforestation, over grazing and construction of roads are some of major causes responsible for degradation of soil health (Semwal *et al.*, 2009; Araujo *et al.*, 2012) [3, 4]. Along with rising human population, climate change and unsustainable use of natural resources affects soil nutrient status of the country (Sarvade *et al.,* 2014) [5] which is an important factor for controlling yields of the crops. In future, sustainable soil conservation efforts would be needed for tackling problems such as soil health depletion, climate change and food insecurity.

Agroforestry is sustainable land use system and it has potential for improving soil physical, chemical and biological properties through multifunctional approach. The combination of trees, crops and livestock mitigates environmental risk, creates a permanent soil cover against soil erosion, minimizes damage from floods and acts as water storage thereby benefit crops and pastures (FAO, 2015) [6]. Nair (1984) [7] has reported that agri-horticultural and agri-pastoral systems have the potential to reduce soil erosion, runoff and to maintain soil organic matter, improve soil physical properties and augment nitrogen fixation and promote efficient nutrient cycling. Agroforestry is also a viable option for climate change mitigation, sustainable development and has the potential to improve the socio-economic conditions of the farmers (Dutt and Thakur, 2004) [8]. Most of the Indian agricultural lands are deprived of some of the essential nutrients for growth and development of crop plants. Chemical fertilizers supplement the nutrient supply but such chemical fertilizers pose serious health hazards and microbial population problem in soil besides being quite expensive and making the cost of production high. The long term use of chemical fertilizers without organic supplements damages the soil properties and causes environmental pollution (Albiach *et al*., 2000) [9].

This scenario has encouraged scientists to use organic materials for improving soil properties and high crop production.

Ocimum sanctum is an aromatic plant distributed throughout the tropical and subtropical climates of Indian subcontinent up to an elevation of 900 m (Raina *et al.,* 2013) [10]. The crop is highly profitable due to the presence of a complex mixture of volatile substances, monoterpenes, sesquiterpenes and their oxygenated analogs present at low concentrations in plants (Lucchesi *et al.*, 2004) [11]. Essential oil of *Ocimum sanctum* finds extensive role in pharmaceutical preparations, perfumes, cosmetics and also as flavoring agent in food items (Raina *et al.*, 2013) [10]. The species is traditionally used in the health care as expectorant, analgesic, anticancer, antidiabetic, antistress, antioxidant and wound healing. Though the production of the species can be increased by supplying the nutrients through chemical fertilizers alone but continuous use of the same on long-term basis may lead to the degradation of the soil health. Usage of organic manures generally improves the soil physical, chemical, biological properties and moisture holding capacity thus helps in enhanced crop productivity. Keeping in view the above facts, the present study was conducted in order to assess the effect of different organic manure doses on soil physico-chemical properties of *Ocimum sanctum* under stone fruit based agroforestry system.

Materials and Methods

The present investigation was conducted at the experimental farm of Department of Silviculture and Agroforestry, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.). The experiment comprised of seven treatments *viz.*, T_1 (15t/ha FYM), T_2 (20t/ha FYM), T_3 (25t/ha FYM), T_4 (180ml/plant Jeevamrut), T_5 (300ml/plant Jeevamrut), T_6 (420ml/plant Jeevamrut) and T_7 (no manure-control) and three distance levels of application from tree trunk *viz*., 1m, 2m and 3m away from tree. The experiment was laid out in randomized block design with three replications. This study consisted of fruit trees *viz*; Peach var. nectarine (*Prunus persica*) and Apricot (*Prunus armeniaca*) as woody perennial and *Ocimum sanctum* as intercrop in agrisilviculture system. Fruit trees were planted in East to West direction at a distance of 9m x 4m. While, the plot size of 3m x 3m and spacing of 45cm x 45cm was maintained for *Ocimum sanctum.* Seedlings of *Ocimum sanctum* were transplanted in the month of June. Light irrigations were given after transplanting to facilitate the establishment of seedlings. The experimental plots were maintained properly and kept free from weeds. FYM was evenly spread and mixed with the soil before transplanting. Thereafter, Jeevamrut (5%) was applied as soil drench @ 30, 50, 70ml per plant after the 30 days of transplanting. Afterwards application was done at 15 days interval till the final harvesting is done (full bloom stage of flowering) with total 6 applications. Thus making total application of 180ml (Palekar, 2006) [12], 300ml and 420ml per plant (Basavaraj *et al*., 2016) [13]. Soil samples were collected from 0-15cm depth at three distances from tree trunk (1m, 2m and 3m away from tree trunk) from each plot before transplanting as well as at the time of harvesting of the crop and collected samples were air dried under shade in laboratory; crushed using wooden mortar and pestle and then sieved through 2 mm plastic sieve. The observations on physico-chemical properties of soil *viz*., soil moisture (%), soil pH, electrical conductivity (ds/m^{-1}), organic carbon (%), available nitrogen (kg/ha), available phosphorus (kg/ha) and available potassium (kg/ha) were recorded. The methods and instruments used for soil physical and chemical analysis have been given in Table 1.

Table 1: Methods and instrument used for soil chemical analysis.

Sr. No.	Parameters	Methods employed	Instrument/ apparatus used
1	Soil moisture	Gravimetric method	-
2	Electrical conductivity	1:2 soil water suspension (Jackson, 1973) [14]	Electrical conductivity meter
3	pH	1:2 Soil water suspension (Jackson, 1973) [14]	pH meter
4	Organic carbon	Rapid titration method (Walkey and Black, 1934) [15]	-
5	Soil nitrogen	Alkaline potassium permangante method (Subbiah and Asija, 1956) [16]	Kjeldhal distillation unit
6	Phosphorous (P_2O_5)	Olsen *et al.* (1954) [17]	Spectronic 20-D+
7	Potassium	Neutral 1 N ammonium acetate solution method (Merwin and Peech 1951) [18].	Flame Photometer

The entire data of the present study were statistically analyzed by using analysis of variance (ANOVA) for Randomized Block Design (RBD) in accordance with the procedure outlined by Gomez and Gomez (1984) [19] where effects exhibited significance at 5 per cent level of probability and then critical difference (CD) was calculated.

Results and Discussion

Soil moisture (%)

Data presented in Table 2 showed that with increase in distance from the tree, soil moisture was significantly decreased. The maximum soil moisture of 9.90% and 9.89% was recorded at a distance of 1m away from tree trunk (D_1) under peach and apricot tree, respectively. However, the minimum soil moisture (9.19% and 9.14%) was observed in D_3 (3m away from tree trunk) under peach and apricot tree, respectively. Tripathi (2012) [20] has reported that moisture content, NPK and other macronutrient were higher under tree cover than in open condition. Among various organic manures treatment, the maximum soil moisture (10.93% and 10.77%) was recorded in T_3 (25t FYM ha^{-1}) under peach and apricot tree, respectively. Similarly, Acharya *et al.* (1988) [21] have also reported beneficial effects on soil structural index, infiltration rate and water retention characteristics of soil with addition of FYM. However, the minimum soil moisture (8.29 % and 8.17%) was observed in T_7 (control-no manure) under peach and apricot tree, respectively. The interaction between different organic manures and canopy exerted a non-significant effect on soil moisture. However, maximum soil moisture was recorded in T_3D_1 (11.20% and 11.27%) and minimum in T_4D_3 (8.38% and 8.24%) under peach and apricot tree, respectively.

EC (dSm^{-1}) and pH

The data presented in tables 3 and 4 revealed that organic manure and their distance of application exerted a significant effect on electrical conductivity and pH. The maximum electrical conductivity (0.24 and 0.23) and pH (7.12 and 7.30) was recorded at a distance of 1m away from tree trunk (D_1) under peach and apricot tree, respectively. However, the minimum electrical conductivity (0.21 and 0.20) and pH (6.54 and 6.64) was observed in D_3 (3m away from tree trunk) under peach and apricot tree, respectively. Yogeshwari (2015) [22] has also reported a significant decline in all soil parameters except bulk density, soil pH and soil iron content with increase in distance from the tree. Among various organic manure treatments, the maximum electrical conductivity (0.28 and 0.27) and pH (7.06 and 7.15) was recorded in T_3 (25t FYM ha^{-1}) under peach and apricot tree, respectively. However, the minimum electrical conductivity (0.19 and 0.19) and pH (6.37 and 6.36) was observed in T_7 (control) under peach and apricot tree, respectively. The interaction between different organic manures and canopy exerted a non-significant effect on EC and pH. However, maximum electrical conductivity (0.29 and 0.29) was recorded in T_3D_2 and maximum pH (7.52 and 7.62) was recorded in T_2D_1. Bowen *et al.* (1988) [23] have also reported that plant residues or litter has multi-beneficial effects on maintenance of soil physical conditions, soil organic matter, provision of nutrients and stimulation of biological activity as well as moderately acidity in soil.

Organic carbon NP and K

It is evident from the tables 5, 6, 7 and 8 that different organic manures and their distance of application exerted a significant effect on organic carbon, N, P and K. Maximum organic carbon (1.94% and 1.75%), available nitrogen (325.18 kg/h and 316.83 kg/h), available phosphorus (50.16 kg/h and 49.41 kg/h) and available potassium (291.15 kg/h and 247.67 kg/h) were recorded at D_1 (distance of 1m away from tree trunk) under peach and apricot tree, respectively. In the present study, the reason for higher organic carbon could be more leaf litter addition at D_1 distance as compared to D_3 distance. Our findings can be supported with results of Khybri *et al*. (1992) [24] who reported that planting trees on field boundaries increased organic carbon, available nitrogen, available phosphorus and potash. Whereas, the minimum organic carbon (1.45% and 1.35%), available nitrogen (306.27 kg/h and 306.17 kg/h), available phosphorus (40.92 kg/h) and available potassium (265.43 kg/h and 235.11 kg/h) was observed in D_3 (3m away from tree trunk) under peach and apricot tree, respectively except for available phosphorous under apricot tree which was recorded minimum in D_2 (39.82). Similarly, Bhat (2015) [25] have also reported maximum available N, P, and K content in soil in S_2 treatment (near the tree i.e. 8x4m) under intercropped conditions as compared to S_0 (sole crop).

Among various organic manure treatments, the maximum organic carbon (2.26% and 2.04%), available nitrogen (346.18 kg/h and 258.36 kg/h), available phosphorus (49.17 kg/h and 48.09 kg/h) and available potassium (331.03 kg/h and 265.41 kg/h) was recorded in T_3 (25t FYM ha^{-1}) under peach and apricot tree, respectively. Bellakki and Badanur (1997) [26] have reported increased organic carbon content with incorporation of FYM or sunnhemp to soil. Similarly, another author (Balaji, 1994) [27] has also noticed higher levels of total nitrogen with application of organic manure either vermicompost or FYM in combination with chemical fertilizers over control (no manure). However, the minimum organic carbon (1.27% and 1.14%), available nitrogen (347.10 kg/h and 265.51 kg/h), available phosphorus (33.07 kg/h and 31.50 kg/h) and available potassium (229.20 kg/h and 224.07 kg/h) was observed in T_7 (control) under peach and apricot tree, respectively. Considering the Jeevamrut doses, soil organic carbon (1.93%) was found maximum in T_6 (420ml/plant Jeevamrut). Chandrakala (2008) [28] has reported that application of liquid manures also lowered the bulk density and increased the organic carbon content. The interaction between different organic manures and canopy exerted a non-significant effect on all soil physic-chemical parameters, except for available phosphorus under Apricot tree where interaction between treatments and different distances from tree exerted significant effect. However, maximum available phosphorous (53.88 kg/h) was recorded at a distance of 1m away from tree when FYM was applied @ 25t ha^{-1} (T_3) which was statistically at par with T_6D_1. Available Phosphorus was also reported higher where plants were grown under tree and supplied with 25t ha^{-1} FYM (Gulabrao, 2016) [29]. Highest available K content of soil has also been reported with the application of FYM by Sharma and Sharma (2002) [30].

Conclusion

The application of organic manures had a significant effect on soil physico-chemical properties of *Ocimum sanctum* with superior performance at FYM @ 25 t $ha^{-1.}$ All the soil physico-chemical parameters *viz.*, soil moisture (11.20% and 11.27%), electrical conductivity (0.29 dSm^{-1} and 0.29 dSm^{-1}), organic carbon (2.35% and 2.12%), available nitrogen (354.97 kg/h and 255.42 kg/h), available phosphorus (55.08 kg/h and 53.88 kg/h) and available potassium (356.40 kg/h and 278.96 kg/h) were highest when a dose of FYM @ 25 t ha^{-1} was applied at a distance of 1m away from tree trunk under peach and apricot based agroforestry system, respectively. This study emphasizes the potential use of organic manures in fruit-based agroforestry systems as an efficient strategy to maximize land use efficiency and improve soil health.

Table 2: Effect of organic manure and distance from tree trunk on soil moisture (%) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	**D_2**	**D_3**	**Mean**	**Outside canopy (mean)**	**Inside canopy (mean)**	**Mean**	**D_1**	**D_2**	**D_3**	**Mean**	**Outside canopy (mean)**	**Inside canopy (mean)**	**Mean**
T_1	10.27	10.19	9.57	10.01	9.47	10.01	9.74	10.13	9.58	9.53	9.75	9.47	9.75	9.61
T_2	10.53	10.44	10.17	10.38	9.82	10.38	10.10	10.76	10.81	9.99	10.52	9.82	10.52	10.17
T_3	11.20	11.06	10.53	10.93	10.05	10.93	10.49	11.27	10.55	10.51	10.77	10.05	10.78	10.42
T_4	9.03	8.77	8.38	8.73	8.01	8.73	8.37	8.95	8.36	8.24	8.52	8.01	8.52	8.26
T_5	9.46	9.22	8.77	9.15	8.44	9.15	8.79	9.49	8.79	8.60	8.96	8.44	8.96	8.70
T_6	10.12	9.80	9.35	9.76	8.83	9.76	9.29	10.09	9.37	9.33	9.59	8.83	9.60	9.21
T_7	8.71	8.57	7.59	8.29	7.80	8.29	8.05	8.51	8.19	7.81	8.17	7.80	8.17	7.99
Mean	9.90	9.72	9.19		8.92	9.61		9.89	9.38	9.14		8.92	9.47	
$CD_{(0.05)}$	T		0.21		T	0.29		T		0.43		T	0.37	
	D		0.14		D	0.15		D		0.28		D	0.19	
	T× D NS				T×D NS			T×D NS				T×D NS		

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk.

Table 3: Effect of organic manure and distance from tree trunk on EC (dSm^{-1}) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	0.25	0.24	0.21	0.23	0.19	0.23	0.21	0.23	0.23	0.20	0.22	0.19	0.22	0.21
T_2	0.26	0.26	0.23	0.25	0.19	0.25	0.22	0.25	0.25	0.21	0.24	0.19	0.24	0.21
T_3	0.29	0.29	0.27	0.28	0.20	0.28	0.24	0.29	0.28	0.25	0.27	0.20	0.27	0.24
T_4	0.24	0.21	0.19	0.21	0.18	0.21	0.20	0.23	0.20	0.19	0.21	0.18	0.21	0.19
T_5	0.22	0.21	0.19	0.20	0.17	0.20	0.19	0.21	0.20	0.18	0.20	0.17	0.20	0.18
T_6	0.21	0.21	0.18	0.20	0.16	0.20	0.18	0.21	0.20	0.18	0.20	0.16	0.20	0.18
T_7	0.20	0.19	0.18	0.19	0.17	0.19	0.18	0.19	0.18	0.17	0.19	0.17	0.19	0.18
Mean	0.24	0.23	0.21		0.18	0.23		0.23	0.22	0.20		0.18	0.22	
$CD_{(0.05)}$	T		0.01		T	0.01		T		0.01		T	0.01	
	D		0.01		D	0.01		D		0.01		D	0.01	
	T×D		NS		T×D	NS		T×D		NS		T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk.

Table 4: Effect of organic manure and distance from tree trunk on soil pH under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	6.89	6.63	6.47	6.66	6.55	6.66	6.61	7.22	6.79	6.54	6.85	6.55	6.85	6.70
T_2	7.52	6.80	6.48	6.94	6.22	6.94	6.58	7.62	6.94	6.58	7.05	6.22	7.05	6.64
T_3	7.34	7.09	6.74	7.06	6.68	7.06	6.87	7.51	7.11	6.84	7.15	6.68	7.15	6.92
T_4	7.18	7.05	6.37	6.86	6.41	6.86	6.64	7.31	7.15	6.53	7.00	6.41	7.00	6.71
T_5	7.06	6.54	7.04	6.88	6.63	6.88	6.76	7.40	6.74	7.17	7.10	6.63	7.10	6.87
T_6	7.34	7.08	6.43	6.95	6.97	6.95	6.96	7.44	7.09	6.51	7.01	6.97	7.01	6.99
T_7	6.52	6.33	6.26	6.37	6.28	6.37	6.33	6.58	6.42	6.32	6.44	6.28	6.44	6.36
Mean	7.12	6.79	6.54		6.54	6.82		7.30	6.89	6.64		6.54	6.94	
$CD_{(0.05)}$	T		0.12		T	0.34		T		0.34		T	0.33	
	D		0.28		D	0.18		D		0.22		D	0.18	
	T×D		NS		T×D	NS		T×D		NS		T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk.

Table 5: Effect of organic manure and distance from tree trunk on soil organic carbon (%) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	2.04	1.65	1.42	1.70	1.30	1.70	1.50	1.85	1.92	1.38	1.72	1.30	1.72	1.51
T_2	2.14	1.75	1.61	1.83	1.35	1.83	1.59	1.93	1.84	1.46	1.74	1.35	1.74	1.55
T_3	2.35	2.3	2.12	2.26	1.86	2.26	2.06	2.26	2.12	1.74	2.04	1.86	2.04	1.95
T_4	1.61	1.44	1.27	1.44	1.16	1.44	1.30	1.5	1.33	1.22	1.35	1.16	1.35	1.26
T_5	1.7	1.65	1.46	1.60	1.29	1.60	1.45	1.4	1.53	1.43	1.45	1.29	1.45	1.37
T_6	2.16	2.14	1.48	1.93	1.49	1.93	1.71	1.81	2.1	1.47	1.79	1.49	1.79	1.64
T_7	1.65	1.35	0.8	1.27	0.73	1.27	1.00	1.47	1.23	0.72	1.14	0.73	1.14	0.93
Mean	1.94	1.76	1.45		1.31	1.70		1.75	1.73	1.35		1.31	1.61	
$CD_{(0.05)}$	T		0.18		T	0.38		T		0.24		T	0.28	
	D		0.14		D	0.20		D		0.18		D	0.15	
	T×D		NS		T×D	NS		T×D		NS		T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk

Table 6: Effect of organic manure and distance from tree trunk on available N (Kg/ha) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	318.85	313.04	306.69	312.86	303.15	312.86	308.01	318.42	322.22	307.19	315.94	303.15	315.94	309.55
T_2	343.61	339.80	328.34	337.25	312.13	337.25	324.69	346.78	353.28	316.65	338.91	312.13	338.90	325.52
T_3	354.97	348.09	335.48	346.18	305.99	346.18	326.08	355.42	356.47	329.40	347.10	305.99	347.10	326.54
T_4	312.15	301.86	299.08	304.36	300.00	304.36	302.18	317.19	205.18	299.74	274.04	300.00	274.04	287.02
T_5	321.61	317.50	314.37	317.83	306.50	317.83	312.16	313.89	325.54	306.48	315.30	306.50	315.30	310.90
T_6	337.42	331.03	324.18	330.88	311.07	330.88	320.98	335.82	342.65	316.95	331.81	311.07	331.81	321.44
T_7	287.64	251.72	235.73	258.36	270.40	258.36	264.38	230.26	299.54	266.74	265.51	270.40	265.51	267.96
Mean	325.18	314.72	306.27		301.32	315.39		316.83	314.98	306.17		301.32	312.66	
$CD_{(0.05)}$	T		21.66		T	22.37		T		38.39		T	32.73	
	D		14.18		D	11.96		D		NS		D	NS	
	T×D		NS		T×D	NS		T×D		NS		T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk

Table 7: Effect of organic manure and distance from tree trunk on available P (Kg/ha) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	49.77	42.44	42.45	44.89	45.26	44.89	45.08	49.08	42.33	44.89	45.43	45.26	45.43	45.35
T_2	52.48	45.48	44.52	47.49	47.00	47.49	47.25	51.19	46.52	44.95	47.55	47.00	47.55	47.28
T_3	55.08	47.29	45.13	49.17	48.30	49.17	48.73	53.88	46.52	43.86	48.09	48.30	48.09	48.19
T_4	48.78	38.94	38.81	42.18	42.28	42.18	42.23	47.56	38.22	40.08	41.95	42.28	41.95	42.12
T_5	50.92	43.46	42.62	45.67	43.81	45.67	44.74	51.34	40.19	41.18	44.24	43.81	44.24	44.02
T_6	53.36	44.31	43.45	47.04	43.86	47.04	45.45	53.25	40.11	41.96	45.11	43.86	45.11	44.48
T_7	40.74	29.05	29.43	33.07	34.49	33.07	33.78	39.56	24.90	30.04	31.50	34.49	31.50	32.99
Mean	50.16	41.57	40.92		43.57	44.22		49.41	39.83	40.99		43.57	43.41	
$CD_{(0.05)}$	T	2.77			T	2.47		T	1.38			T	2.70	
	D	1.81			D	NS		D	0.90			D	NS	
	T×D	NS			T×D	NS		T×D	2.39			T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk.

Table 8: Effect of organic manure and distance from tree trunk on available K (Kg/ha) under different agroforestry system.

Distance Treatment	Peach							Apricot						
	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean	D_1	D_2	D_3	Mean	Outside canopy (mean)	Inside canopy (mean)	Mean
T_1	286.63	278.17	269.08	277.96	230.52	277.96	254.24	250.96	241.26	231.56	241.26	230.52	241.26	235.89
T_2	327.04	300.45	287.19	304.89	222.76	304.89	263.83	257.32	249.03	239.44	248.60	222.76	248.60	235.68
T_3	356.40	330.92	305.78	331.03	257.83	331.03	294.43	278.96	261.42	255.86	265.41	257.83	265.41	261.62
T_4	265.84	265.17	244.74	258.58	227.58	258.58	243.08	232.01	230.37	229.13	230.50	227.58	230.50	229.04
T_5	273.11	272.10	262.29	269.17	222.14	269.17	245.65	237.64	234.18	232.65	234.82	222.14	234.82	228.48
T_6	279.63	309.68	269.75	286.35	232.54	286.35	259.45	248.09	237.67	235.87	240.54	232.54	240.54	236.54
T_7	249.40	219.04	219.16	229.20	201.79	229.20	215.50	228.74	222.21	221.25	224.07	201.79	224.07	212.93
Mean	291.15	282.22	265.43		227.88	279.60		247.67	239.45	235.11		227.88	240.74	
$CD_{(0.05)}$	T		29.76		T	29.28		T		17.50		T	26.32	
	D		19.48		D	15.65		D		NS		D	NS	
	T×D		NS		T×D	NS		T×D		NS		T×D	NS	

*T= Tree; D=distance of application from tree trunk; TxD= interaction between tree and distance of application from tree trunk.

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