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Contribution of *Hagenia abyssinica* and *Schefflera abyssinica* Selected Parkland Trees on Soil Properties and Wheat Productivity in Ana Sora District of Guji Zone, Southern Ethiopia

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Abstract **Original Research Article**

The study was conducted to evaluate the contribution of *Hagenia abyssinica* and *Schefflera abyssinica* selected parkland trees on soil properties and wheat productivity in Ana Sora District of Guji Zone, Southern Ethiopia. Key informant interview was used to identify farmers selection criteria and purpose of keeping parkland tree species of the study area. The study results showed that, *Schefflera abyssinica*, *Hagenia abyssinica*, *Millettia ferruginea*, *Cordia africana* and *Croton macrostachyus* were the most preferred top five parkland tree species of the study area respectively. Regarding selection of parkland tree Species for soil and crop related studies the most preferred 1st and 2nd ranked parkland trees namely; *Schefflera abyssinica* and *Hagenia abyssinica* were selected. Three isolated trees of each species which had similar management practice and grown under similar soil types, climate and landscape were selected on each of the study site and the canopy coverage of each tree was divided into three radial distances (2.3m,4.6m and 15m). The results of the study indicated that except for soil particle fractions the amount of major soil fertility parameters such as soil pH, CEC, OC, OM, TN and available P, under canopies of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees were higher than the open cultivated land. Moreover, the effects of the two parkland trees on grain yield of wheat was higher within the canopy of the tree than outside of the canopy. Therefore, the findings suggest that the maintenance of soil fertility and improvement in grain yield of wheat can be attained by incorporation of the two parkland trees in the study area and agricultural landscapes of similar agro-ecological conditions.

Keywords: Farmers preference, *Hagenia abyssinica*, Parkland trees, *Schefflera abyssinica,* Soil property, Wheat productivity.

INTRODUCTION

Parkland trees are a very common type of agroforestry system in the tropics and characterized by well known scattered trees on cultivated and recently fallowed lands which is developed as a result of crop cultivation on a piece of land that became a permanent activity (Raj and Lal, 2014). Scattered trees are characteristics of a large part of the African agriculture landscape. The trees are deliberately associated with the agricultural environment because of their specific use (ICRAF, 2000). The integration of parkland trees into farms has the potential to enhance soil fertility and structure, enhance carbon sequestration (biogenic carbon capture and storage), reduce erosion and surface run-off, improve water quality, enhance biodiversity, and increase soil organic carbon (An *et al.,* 2023).

Parkland trees on crop lands are known to bring about changes in micro-climatic, floral, faunal and other components of the ecosystem through bio-recycling of mineral elements, environmental modifications (including thermal and moisture regime) and changes in floral and faunal composition (Shukla, 2009). Parkland trees can improve the nutrient balance of soil by reducing unproductive nutrient losses from erosion and leaching and by increasing nutrient inputs through nitrogen fixation and increased biological activities by providing biomass and suitable microclimate (Clement and Olusegun, 2010). Moreover, parkland agroforestry which is a system practiced for many local populations is very important for food security, income generation and environmental protection, and is found at different corners of the world, primarily in the semi-arid and sub-humid zones of Africa (Boffa, 1999). Hence, implementing agroforestry systems in resource poor farming households is considered to mitigate soil nutrient mining (Gladwin *et al.,* 2002). Integration of legume multipurpose trees into agricultural systems, adds biologically fixed nitrogen and other important nutrients to the soil in a way that complements the crops grown in association with the trees (Akinnifesi *et al.,* 2010; Rosenstock *et al.,* 2014).

Agroforestry practice is an aged practice in the Ethiopian farming systems of which parkland trees comprise the large part of agricultural landscapes and it is also the most dominant agroforestry practice in the semi-arid and sub-humid zones of Ethiopia (Kindeya, 2004). Furthermore, the integration of tree and shrub species into agriculture emerged long time ago and the practice has developed into a number of distinguished traditional agroforestry systems in different parts of the country mainly in southern and south western Ethiopia (Tesfaye Abebe, 2005). Some good examples of parkland agroforestry practice in Ethiopia are including *Cordia africana* intercropping with maize in Bako and western Ethiopia, *Acacia albida*-based agroforestry in the Hararghe Highlands and Debrezeit area (Hoekstra,1990). In addition to this in the rift valley parts of the country the system is the most common cultivation method which is very familiar to the farmers (Abebe ,2000).

In Ethiopia, parkland agroforestry practice can be known by potential for supplying heating, cooking, household utensils, cultural values, provision of pollen and nectar for honey production, construction of houses and handles of farm implements (Mesele, 2007). In addition, the system is known for soil fertility improvement, economic benefits, fodder values, employment opportunities and contribute to regional and national economy (Abebe, 2005). The enhancement of soil fertility and yield improvement under parkland tree canopies in different parts of the country reported by different scholars. For example, *Faidherbia albida* parklands modify soil moisture availability through increased infiltration, (Tadesse *et al.,* 2001), *Cordia africana* has significantly more nutrients in the top soil underneath its canopy, improves soil fertility in southern Ethiopia, (Zebene 2003) and *Faidherbia albida* and *Croton macrostachyus* tree species significantly improved soil properties and grain yield of Maize under tree canopies in Southern Ethiopia (Belay *et al.,* 2014).

Scattered trees on agricultural lands, that is, parkland agroforestry systems, are commonly practiced in different agroecology of Guji Zone, Oromia region, in Southern Ethiopia. In Highland agroecology of Ana Sora district smallholder farmers have culture of tree planting and managing naturally grown indigenous tree species are widely adopted by farmers, as a dominant feature of agricultural landscapes and thirty one parkland tree species belonging to 26 families were identified (Sintayo and Aschalew, 2024). However, the contribution parkland tree species on soil fertility enhancement and crop productivity regardless of the farmers maintain these parkland tree species on their agricultural fields were not yet studied. Therefore, the objective of this study was to evaluate the contribution of *Hagenia abyssinica* and *Schefflera abyssinica* selected parkland tree species on soil properties and wheat productivity in Ana Sora District of Guji Zone, Oromia region, in Southern Ethiopia.

MATERIALS AND METHODS

Description of the study area

The study was carried out in Ana Sora District of Guji Zone, Oromia region, in Southern Ethiopia. Ana Sora district is found at a distance of 414 km from Addis Ababa, capital city of Ethiopia. Astronomically, the study district is located within the latitude of $6^0$20’30’’-$5^0$57’30’’ North and longitude of $38^0$39’30’’-$38^0$57’30’’East (Figure 1). Ana Sora district receives an annual rain fall of about 1400-1800 mm, the annual temperature of the district ranged from 17.5c^0-28c^0 and the altitude ranges from 1900-2850 meters above sea level. The district's two main rainy seasons are spring and autumn. Through out the majority of the region, autumn brings both heavy and minor rains. In the spring which runs from late February to early May, 78% of the annual rainfall is thought to fall. Autumn is the least rainy season in the area, with precipitation starting in September and lasting through November. The district is characterized by mixed economic activities, mainly agricultural practices which constitute the major livelihood of the people. It produces diverse cereal crops such as maize, bread wheat and food barley and highland pulse crops like faba bean and field pea and other horticultural and root crops.

Methods of data collection

Selection of Parkland Tree Species

In order to identify farmers selection criteria and purpose of keeping of parkland tree species on their farm lands, key informant interview was used. Key informants used in this study are persons who are knowledgeable about parkland tree species and who have continuously lived for a long period in the villages. To select individual household heads that could identify for key informants, a village tour was made with development agents. Accordingly, from each kebeles 5 key informants were selected and a total of 10 knowledgeable key informants from two kebeles were used for farmers preferences of top 5 parkland tree species of the study area. According to key informants farmers preferences of parkland tree species depends on their benefits such as timber and construction value, fuel wood, shade, bee forage, beehive construction and soil fertility improvement values that can be drawn from keeping the tree on their farm lands. To evaluate farmers’ parkland tree species preferences, key informants were asked to rank the five most preferred parkland tree species among the species found in their parklands, and then the total score was calculated. Based on their total score, farmers of the study area selected top 5 parkland tree species in the order of accordingly, *Schefflera abyssinica, Hagenia abyssinica, Millettia ferruginea, Cordia africana* and *Croton macrostachyus* respectively.

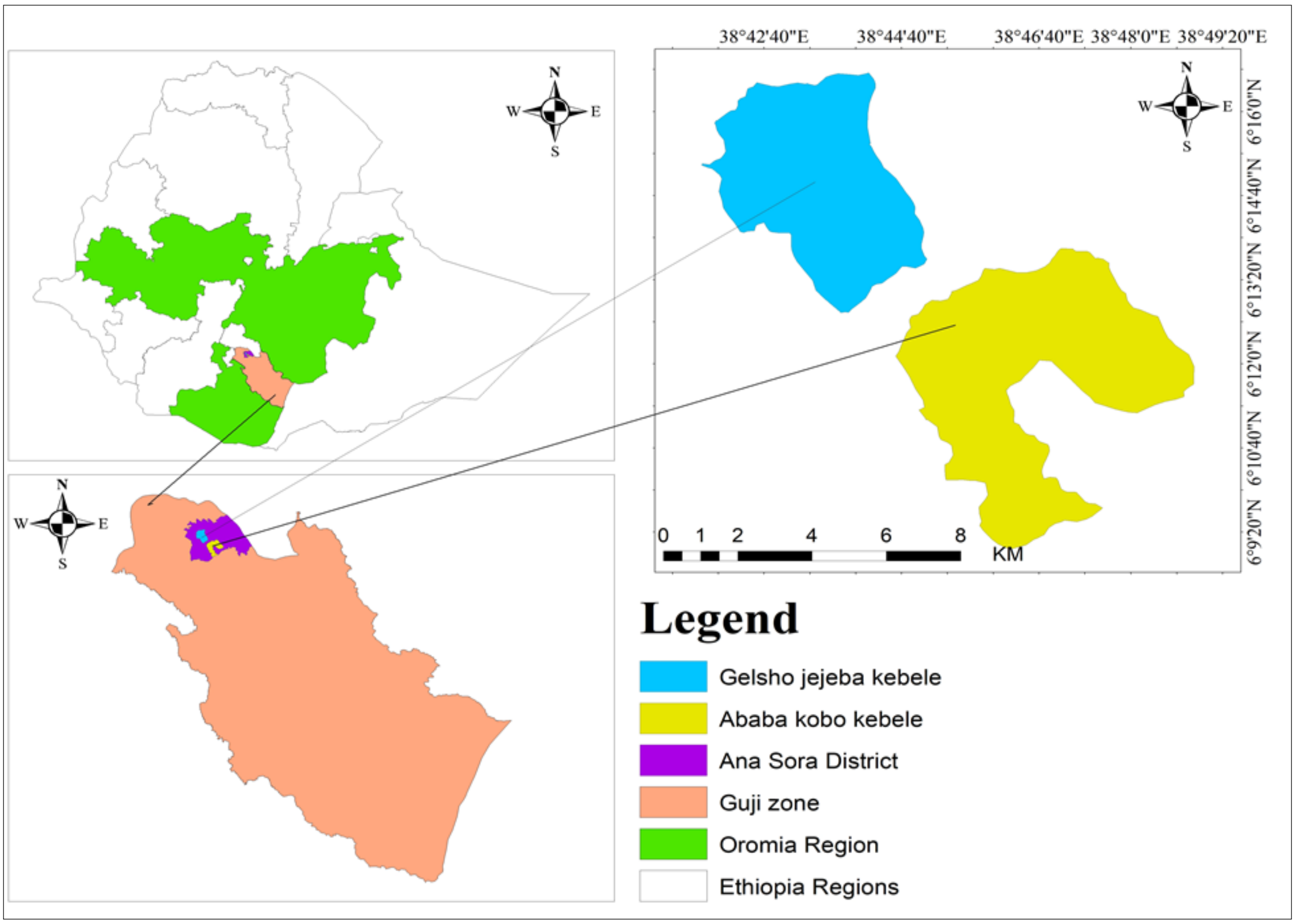

Figure 1: A map shows the location of the study area

Selection of parkland tree species for soil and crop related studies

Regarding selection of parkland tree species for soil and crop related studies the most farmers preferred 1st and 2nd ranked parkland tree species namely; *Schefflera abyssinica* and *Hagenia abyssinica* were selected for soil and crop related studies. Three isolated parkland trees of each species which had similar management practice and grown under similar soil types, climate and landscape were selected on each of the study site and the canopy coverage of each parkland tree was divided into three (2.3m, 4.6m and 15m) radial distances.

Planting of wheat under and outside the canopies of parkland trees

After selecting the experimental trees with three replication (three matured tree of *Hagenia abyssinica* and *Schefflera abyssinica*) improved bread wheat variety which is called Miju was planted in field under and outside the canopies of *Hagenia abyssinica* and *Schefflera abyssinica* selected parkland tree species. For planting of wheat under and outside the canopies of selected parkland tree species the area covered under canopy of each tree at two intervals (2.3m and 4.6m) and at 15m distance away from the tree trunk was covered by planting of wheat.

Soil sampling collection

Composite soil samples were collected from each of the three treatments (sampling distance from the tree base 2.3m, 4.6.m and 15m). The two interval distances (2.3m and 4.6m) under canopy of the trees was used based on their canopy coverage and at a distance of 15m it was used as a control to minimize the effects of the tree canopies. Replicate soil samples were taken from each plot. For *Hagenia abyssinica* and *Schefflera abyssinica* grown scattered in the farm mixed with bread wheat, soil samples were taken under the tree canopy at one depth 0–20 cm at three distances in four different directions. Soils from each sampling distance were bulked to obtain a composite sample. Finally, from each radius, 1.5 kg of sample was taken for soil analyses. Collected soil samples were passed through a 2 mm soil sieve in preparation for laboratory analysis and further sieved to pass through a 0.5 mm size sieve for the analysis of selected soil physico-chemical properties and sent to Horticoop Ethiopia, Soil, Water and Plant Analysis Laboratory.

Grain yield data collection

In each cropping season, the yield of bread wheat harvested from each radial distances (2.3m,4.6m and 15m) was measured for two consecutive years. The manual harvesting of wheat production from under canopy of trees and far away from tree trunks was conducted at a proper harvesting time for assessing the wheat grain yield on farm lands of the study area.

Soil laboratory analysis

Analysis of soil physical and chemical properties

From the soil physical properties, soil texture was determined by hydrometer method (Gee and Bauder, 1982). Among the soil chemical properties, Total Nitrogen (TN) was analyzed by Kjeldahl method (Jackson, 1958); available phosphorus (P) by Olsen method (Olsen and Sommers, 1982); soil organic carbon (SOC) by Walkley and Black oxidation method (Chesworth ,2008). Cation Exchange Capacity (CEC) using the ammonium acetate method (Houba *et al.,* 1986). The pH of the soil was measured potentiometrically using a digital pH meter in the supernatant suspension of 1:2.5 soils to water ratio. The organic matter content of the soil was calculated by multiplying the organic carbon percentage by 1.724.

Statistical analyses

Farmers preference ranking of parkland tree species of the study area were conducted by using ten randomly selected key informants. Wheat grain yield and yield attributing data and soil sample data was analyzed using analysis of variance (ANOVA). The treatment means that were significantly different at a 5% level of significance were separated using Duncan and LSD tests by using Gen stat 18th Edition Software Programme.

RESULTS AND DISCUSSION

Farmers Preferences of parkland tree species

Smallholder farmers of the study area have culture of tree planting and conserving naturally regenerated tree species on their farm lands for the purpose energy sources, soil fertility improvement, provision of pollen and nectar for honey production, construction materials, economic benefits, fodder values and shade for underneath crops and animals. The finding of the current study is consistent with the study results of Desalegn and Zebene (2016); Goremsu *et al.,* (2023) reported that tree services and products most preferred by farmers were fuel wood, fodder, soil fertility and erosion control, fruits and pole for construction. This study showed that, from the commonly used parkland tree species of the study area, small holder farmers have their own preferences of tree species. Accordingly, the five most preferred parkland tree species based on their preference criteria were; *Schefflera abyssinica, Hagenia abyssinica, Millettia ferruginea, Cordia africana and Croton macrostachyus* were ranked 1st, 2^{nd,} 3rd, 4^{rth} and 5th respectively (Figure1).

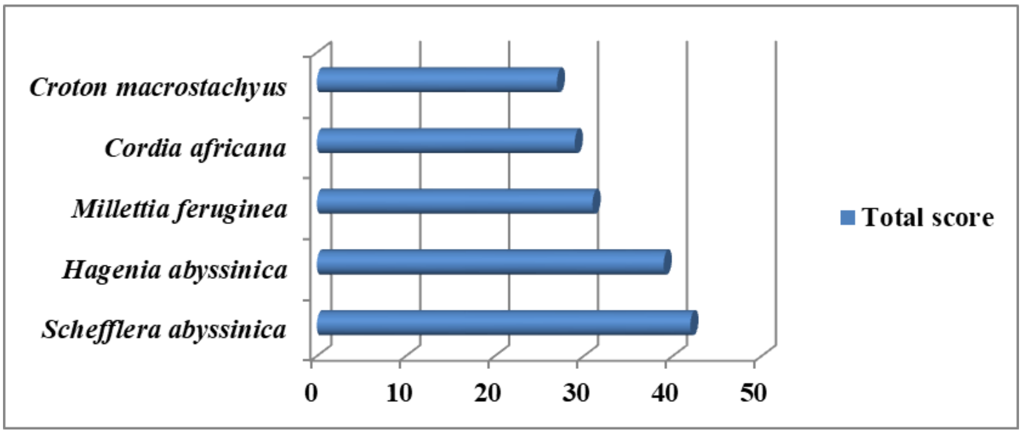

Figure 2: Farmers preference of park land tree species in Ana Sora District of Guji Zone, Southern Ethiopia

Contribution of *Hagenia abyssinica and Schefflera abyssinica* Parkland Tree species on soil properties

Soil Texture

The texture of the study area was categorized under clay loam soils according to USDA textural classification with higher proportions of clay. This may be due to the soil being from similar parent material, vegetation cover and topography. The results of textural analysis also indicated that soil particle fractions of sand and clay were significantly varied with distance from the tree trunk. The findings of this study was similar with former study results of Amanuel Tilahun (2022) for *Acacia abyssinica* and *Albizia gummifera* who reported significant amount of sand along different radial distances under the tree canopies. Moreover, Pandey *et al*. (2000) reported a significant influence of *Acacia nilotica* on sand and clay fractions horizontally as a function of distance from tree trunks.

Soil pH

The soil pH result revealed that under canopy of the selected parkland tree species it was significantly higher under the tree trunks than the open field (Table 1). The soil pH of the study area ranged from 6.23 under the tree and 5.35 in open lands for *Hagenia abyssinica*. However, the soil pH ranged from 6.36 under the canopy of *Schefflera abyssinica* and 5.26 in open fields. The measured soil pH decreased with increasing distance away from the base of the tree i.e. it was slightly higher beneath the trees and slightly lower in the open cultivated land. The higher pH value recorded under tree canopy might be due to its canopy cover, which may lead to increasing volumes of leaf litter and other organic material available to the soil than relative to open fields. This finding is in agreement with previous studies in different sites, where Alemayehu *et al.,* (2017) for *Cordia africana* and *Erythrina abyssinica,* Souza *et al*., (2012) for soil properties in coffee agroforestry systems and Aschalew (2022) for *Albizia gummifera* reported that the soil pH value was higher under tree canopies than in an open area.

Organic carbon

The soil organic carbon was significantly (P<0.05) affected by tree species and distance from the tree canopy. Accordingly, a gradual and significant decrease in soil organic carbon was observed with increased distance away from the tree trunk (Table 2). The higher soil organic carbon of 3.74% and 3.72% were recorded under canopy of the *Hagenia abyssinica* and *Schefflera abyssinica* trees respectively than adjacent open fields. This variation of organic carbon with distance away from the tree canopies was quite logical as the higher contents of organic carbon under the tree canopies were due to the leaf litter fall and decomposition of dead roots from the tree. In line with this study, Tadesse *et al.,* (2001); Abebe *et al.,* (2001) and Gizachew *et al.,* (2015) on their study results reported that an increase in soil organic carbon under *Millettia ferruginea, Cordia 252fricana* and *Hagenia abyssinica* tree canopies than outside the canopy coverage.

Organic matter

The soil Organic matter was significantly (P<0.05) higher under tree canopies of both trees than outside the canopy coverage (Table 2).The highest 6.44% and 6.41% organic matter were recorded under canopies of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees respectively (Table 2).This variation in organic matter with distance away from the tree canopy could be due to decompositions of the plant residue: leaf litters fall, dead roots from the tree as compared to the adjacent open areas. This finding is in agreement with previous study of (Zebene and Agren, 2007) who recorded higher organic carbon under canopy of *Cordia africana* and *Millettia ferruginea* trees than that of open area.

Table 1. Soil Physco-chemical properties under canopy of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees in Ana Sora District, Southern Ethiopia

Parkland Tree Species	Radius(m)	Soil properties at surface soil (0-20cm)				
		Sand (%)	Silt (%)	Clay (%)	pH	CEC (meq/100gm
		Mean (Std Dev)				
Hagenia abyssinica	2.3	31.5±4.23^b	30.5±3.33^a	38±6.56^a	6.14±0.33^a	35.48±5.09^a
	4.6	31.8±5.22^b	30.7±4.23^a	37.5±6.43^a	6.0±0.35^a	34.33±5.28^a
	15	38±5.22^a	30.5±5.21^a	31±3.51^b	5.35±0.13^b	27.12±5.53^b
Schefflera abyysinica	2.3	31±5.55^b	31±4.55^a	38±5.24^a	6.33±0.41^a	34.22±5.55^a
	4.6	31.7±4.65^b	30.8±3.22^a	37.5±3.46^a	6.12±0.43^a	33.68±4.65^a
	15	37±4.55^a	29.5±4.12^a	33.5±5.13^b	5.26±0.21^b	28.31±4.58^b

**Mean values in the same column with the same superscript are not significantly different*

Cation exchange capacity (CEC)

The result of CEC showed a highly significantly (P<0.05) affected by all of the trees species and distance from the tree canopy. A gradual and significant decrease in the values of CEC was observed as the distance from the tree trunks increased (Table 1). This could be mainly due to high organic matter accumulation under the tree canopies than the open fields. According to Jones (2001), with an increase in organic matter under the canopies of trees, the total negative charge of the soil increases, which in turn increases the CEC of the soil. The highest values of 35.48 and 34.22 CEC was recorded at radius of 2.5 under canopy *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees respectively (Table 1). The findings of this study was in agreement with the study results of Abebe *et al*., (2001) for *Cordia africana* in western Oromia and Tadese *et al*. (2000) for *Millettia ferruginea* in southern Ethiopia. Moreover, a significant increase in soil CEC has also been reported by Belay *et al.,* (2014); Asaye (2017) and Aschalew and Zebene (2018) in other parts of Ethiopia.

Total Nitrogen

The soil analysis results showed that, total soil nitrogen was influenced by the presence of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees. The total nitrogen contents of the soils showed the same trend as soil organic carbon. This suggests that the main source of N is organic matter. The total nitrogen content was decreased with increasing distance from the tree trunk and it was higher under the canopy of the tree compared to the open area (Table 2). The observed higher total nitrogen under canopy of both parkland trees as compared to open area might be due to leaf litter fall and decomposition of dead roots from the tree and nutrient cycling and nitrogen fixation behavior of the tree. In line with present study findings, Tadesse *et al*. (2000) for *Millettia ferruginea,* Zebene and Agren (2007) for *Millettia ferruginea,* Berhe *et al.,* (2013) for Ficus thonningii and Jirenga *et al*. (2005) for *Cordia africana* and *Crotonmacrostacyus* were found higher total soil nitrogen under tree canopies than in open fields.

Available Phosphorus

The mean concentration of available phosphorus (AP) recorded under the canopies of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees were significantly ($P<0.05$) higher than open fields (Table 2). The higher concentration of soil phosphorus under the canopies of the tree species might be attributed to the higher accumulation of organic matter through litter fall and decomposition of dead roots from the tree. Brady and Weil (2002) also on their study findings indicated that, the horizontal variation could be attributed to high organic matter accumulation under the tree canopy than in open fields. Decomposition of organic matter results in release of phosphorus containing materials, which increase the availability of phosphorus. The findings of present study is in agreement with several reports which was conducted in different areas by Pandey *et al*. (2000) for *Acacia nilotica,*Tadesse *et al.,* (2000) for *Millettia ferruginea,* Belay *et al.,* (2014) for *Faidherbia albida* and *Croton macrostachyus* and Aschalew and Zebene (2018) for *Ficus sur* and *Cordia africana* were reported higher value of available phosphorus under tree trunks than in open fields.

Table 2. Physco-chemical soil properties under canopy of selected parkland tree species in Ana Sora District, Southern Ethiopia

Parkland Tree Species	Radius(m)	Soil properties at surface soil (0-20cm)			
		OC%	OM%	TN%	AV.P(ppm)
		Mean(Std Dev)			
Hagenia abyssinica	2.3	3.74 ± 0.29^a	6.44 ± 0.23^a	0.45 ± 0.03^a	11.22 ± 1.04^a
	4.6	2.74 ± 0.23^b	4.72 ± 0.11^b	0.28 ± 0.02^b	9.89 ± 0.84^b
	15	2.61 ± 0.27^b	4.50 ± 0.13^b	0.21 ± 0.02^c	8.78 ± 0.63^b
Schefflera abyysinica	2.3	3.72 ± 4.23^a	6.41 ± 0.29^a	0.44 ± 0.04^a	10.03 ± 0.95^a
	4.6	2.54 ± 4.23^b	4.41 ± 0.33^b	0.26 ± 0.03^b	8.78 ± 0.73^b
	15	2.50 ± 4.23^b	4.31 ± 0.28^b	0.22 ± 0.02^c	8.65 ± 0.59^b

******Mean values in the same column with the same superscript are not significantly different*

Contribution of *Hagenia abyssinica and Schefflera abyssinica* parkland tree species on wheat yield and yield attributing components

Plant height

The study showed that there was no significant difference in the mean value of plant height due to response to the radial distance from the tree trunks of both parkland tree species (Table 3). In this regard, numerically for *Hagenia abyssinica* and *Schefflera abyssinica* trees the shortest plant height of (88.8cm and 84.8) was recorded at 15m distance. While, the longest plant height of 90.1cm and 85.8 cm was recorded at radial of 2.3m respectively. According to Wang et al. (2017), plant height is one of the most significant agronomic characters of production which has to infer the crop performance. It could directly show overall plant progress and is extensively prognostic of final yield and biomass. In support of this study, Hailemariam et al., (2010) who studied the effect of Balanites aegyptiaca L. Del, a potential tree for parkland agroforestry systems on sorghum yield observed no significant difference in plant height under canopy of the tree and among treatments that were grown at a different distance away from the tree trunk including the control plot grown where the tree influence on the sorghum crop proved to be insignificant.

Table 3: The effect of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees on wheat yield and yield attributing components at different distances from tree trunk

Distance from the tree trunks	*Hagenia abyssinica*				*Schefflera abyssinica*			
	PH(cm)	SL (cm)	TSW (gm)	GY (kun/ha)	PH (cm)	SL (cm)	TSW (gm)	GY (ku/ha)
2.3 m	90.1^a	9.5^a	38.40^a	23.51^a	85.8^a	8.80^a	35.77^a	22.17^a
4.6m	89.30^a	6.8^b	35.60^b	21.00^b	84.9^a	8.96^a	34.43^a	21.57^a
15m	88.8^a	6.6^b	30.80^c	19.83^b	84.8^a	6.26^b	31.07^b	18.40^b
Mean	89.41	7.52	34.93	21.47	85.2	8.01	33.76	20.71
CV%	1.9	5.1	1.9	5.7	0.9	4.1	2.4	2.2
L.S.D	NS	0.768	1.32	2.44	NS	0.65	1.59	0.92

******Mean values in the same column with the same superscript are not significantly different, PH=plant height, SL=spike length, TSW=Thousand seed weight, GY=Grain yield*

Spike length

As the findings of this study showed that, the mean value of wheat spike length was significantly ($P<0.05$) different at radial distances of the *Hagenia abbysinica* parkland tree (Table 3). The maximum 9.5cm spike length was obtained at a 2.3m radial distance from the tree trunk. The recorded spike length at a radial distance of 4.6m and 15 m were 6.8cm and 6.6cm respectively. However, in terms of spike length among the two radial distances (4.6m and 15m) statistically a significant differences were not recorded. The analysis of variance also showed that, the value of spike length obtained at a 2.3m and 4.6m distances from the *Schefflera abyssinica* parkland tree trunk was significantly ($P<0.05$) higher than at a 15m radial distance. Accordingly, 8.96cm, 8.80cm and 6.26cm of spike length were recorded at a 4.6m, 2.3m and 15m radial distances respectively. The highest spike length recorded under radial distance of tree canopy (2.3m and 4.6m) might be due to the plants in this distance can benefit from the tree's litter fall and organic matter addition.

Thousand seed weight

This study showed that, there was a significant difference ($P<0.05$) in thousand seed weight was recorded among the different distances of tree trunks (Table 3). The highest 38.40gm of thousand seed weight was recorded at a 2.3m distance from *Hagenia abbyssinica* tree trunk (Table 3). Moreover, 35.60gm amount of thousand seed weight recorded at a 4.6m edge of the canopy of *Hagenia abyssinica* was significantly ($P<0.05$) higher than amount of recorded at open fields of 15m. In terms of *Schefflera abyssinica* parkland tree, the mean value of thousand seed weight recorded at a 2.3m and 4.6m radial distances were significantly($P<0.05$) higher than the open fields that was situated at 15m. Moreover, the mean value of thousand seed weight recorded at a 2.3m and 4.6m radial distances were not statistically different and 35.77gm and 34.43gm were recorded respectively (Table 3). The maximum thousand seed weight obtained under tree canopies might be because of crops near the canopy have a better chance of getting decomposed soil from the tree's falling litter. However, at a distance of 15 meters from the tree, it is deprived of the fertile soil and moisture retention provided by the tree canopy, resulting in a lower thousand seed weight.

Total Grain yield (Kun/ha)

According to this study, the wheat yield showed a significant difference ($P<0.05$) among the 2.3m, 4.6m and 15m radial distances of the *Hagenia abyssinica* and *Schefflera abyssinica* tree trunks (Table 3). The highest grain yields of 23.51 kun/ha was recorded at a 2.3m mid canopy of *Hagenia abyssinica* and it was significantly higher than total grain yields obtained at a 4.6m edge of canopy and 15m radial distance from tree trunk. Whereas, the total grain yield recorded at a 4.6m and 15m radial distance were 21 kun/ha and 19.83kun/ha respectively and significant differences were not observed between the two radial distances. The effect of *Schefflera abyssinica* parkland tree on total grain yield at different distance from tree trunk was showed significant variation (Table 3). The highest mean value of wheat grain yield of 22.17 kun/ha and 21.57kun/ha were found at 2.3m and 4.6m from the tree trunk and the lowest mean value of wheat grain yield (18.4 kun/ha) was recorded at 15m (Table 3). The increase in wheat grain yield under the trees could be due to improvement of soil properties under the tree canopies than the open fields. Moreover, soils under tree canopies were more fertile than far from the tree trunks due to higher accumulation of soil organic matter and nutrient cycling. In agreement with this study, Abebe (2006) reported increased grain yield of sorghum and haricot bean under the canopy of *F. albida*, *C. africana* and *C. macrostachyus* trees as compared to the open fields.

CONCLUSION AND RECOMMENDATION

The present study has provided valuable information on contribution of parkland tree species on soil properties and bread wheat productivity of the study area. Smallholder farmers of the study area have their own preferences of parkland tree species based on the following criteria such as soil fertility attributes, construction values, bee forages, fodder values, serving for shade and used for fuel wood for energy sources of households. Based on their preferences, *Schefflera abyssinica, Hagenia abyssinica, Millettia ferruginea, Cordia africana and Croton macrostachyus* parkland tree species were ranked 1st, 2nd, 3rd, 4rth and 5th respectively. Based on the farmers preference criteria, two parkland tree species namely; *Schefflera abyssinica* and *Hagenia abyssinica* and that are ranked 1st and 2nd and grown commonly on croplands were selected to evaluate their effects on soil properties and wheat productivity. The study results revealed that, the highest soil pH, CEC, OC, OM, TN and Available P were recorded under canopy of *Hagenia abyssinica* and *Schefflera abyssinica* parkland trees than in open fields. Similarly, except plant height the maximum thousand seed weight, spike length and total grain yields were obtained under tree canopies than far away from tree trunks.

Therefore, the findings suggest that retaining both tree species and incorporating into annual cropping systems in the study area and elsewhere having similar agroecology is of paramount importance for soil fertility improvement and to improve food security of small farming households. Because, both parkland tree species are very important in soil fertility maintenance due to their green leaves decompose rapidly to release nutrients within a growing season. Besides, the trees provide fuel wood, construction material, animal fodder, bee forage and other benefits that are vital to the rural communities. Therefore, parkland agroforestry practice involving *Hagenia abyssinica* and *Schefflera abyssinica* can be used as an economically feasible, environmentally friendly and sustainable alternative to maintain soil fertility to resource poor farmers of the study area and in similar agro-ecological conditions.

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