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The Effect of *Acacia tortilis* and *Balanites aegyptica* Trees on Fodder Quality: The Case of Mieso District, West Hararghe, Oromia National Regional State, Ethiopia

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Abstract: *Acacia tortilis* and *Balanites aegyptica* trees are a multipurpose tree species that produces diverse socio- economic and ecological benefits. These trees are grown commonly on farm land in Mieso district but scientific information is not yet documented about their effect on fodder quality. Thus, this study was initiated to investigate the effect of these two tree species on leaf foliar macronutrients and proximate chemical concentrations for animal feed in Mieso District, Oromia, Ethiopia. Representative foliar samples from *A. tortilis and B. aegyptica* trees replicated four times were collected. From each sampled tree, fully matured and expanded green leaves in all compass directions from different crown positions were collected and evenly mixed to form 1 Kg of fresh leaves per sampled tree. The collected leaf samples were air dried. After air drying, the leaf samples were oven dried at 80°C till constant weight was achieved. Moreover, the leaf Dry Matter (DM), Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE) and ash of the samples were determined. With the regard to leaf macronutrient, only leaf foliar nitrogen concentration was revealed significant variation between the two species whereas among the leaf proximate chemical composition %DM, %CP, %DCP and %CF were showed significant variation (<0.05) between the two species. Thus, A. tortilis and B. aegyptica trees have the potential to provide quality animal feed that contribute to the productivity of the livestock through the provision of their nutritive value of the fodder, and thus, retaining of this tree on farm land with proper management like pruning, pollarding, lopping and crown opening could able to contribute to the livelihood of the community through improving the productivity of livestock.

Keywords: *Balanites aegyptica*, *Acacia tortilis*, Leaf Proximate Chemical Composition and Leaf Fodder

1. Introduction

Agroforestry is recognized as a land use option in which trees provide both products and environmental services. Akinbile *et al.* [1] described agroforestry as a deliberate integration of woody perennials with agricultural crops and/or animals on the same land management unit, with the aim of increasing income through the use of economic trees. It is alternative land management system which has immense potential to solve global challenges like deforestation, unsustainable cropping practices, loss of biodiversity, increased risk of climate change, rising hunger, poverty and malnutrition [2]. A scattered tree on crop land has a positive influence on maintaining soil fertility via addition of nutrient to soil through biological nitrogen fixation and efficient nutrient cycling [3-5]. As compared to treeless area, the microclimatic variables such as air temperature, soil temperature and soil moisture beneath tree canopy modified due to the influence of trees on radiation flux, air temperature and wind speed [6].

Agroforestry involves managing interactions between tree and non-tree components to produce diversified sustainable production system. The magnitude of positive and/or negative influence of trees on crop yield and /or livestock depends on management variables, canopy and root architecture, spatial and temporal arrangement, age and size of the tree and ecological type [5]. Therefore, understanding of the biophysical interactions of trees and livestock different ecological settings is vital to properly manage farm trees [7]. In this context, scattered *A. tortilis and B. aegyptica* trees on farm field are common in Mieso District, and thus, information on their interaction with animal via provision of quality feed need to be assessed so as to manage the system properly and enhance its productivity. In this regard, scientific information about the effect of *A. tortilis and B. aegyptica* trees on fodder qualities was not so far documented. Thus, this study was initiated to reveal the effects of *A. tortilis* and *B. aegyptica* trees leaves nutritional quality as animal feed.

2. Methodology

2.1. Descriptions of the Study Site

2.1.1. Location

The study was conducted in Mieso district, Hararghe, Oromia National Regional State, located at the distance of 300 km east of Addis Ababa. The study area is situated between 40°21′0″ E and 40°57′44″ E; and 8°51′0″ N and 9°36′0″ N (Figure 1).

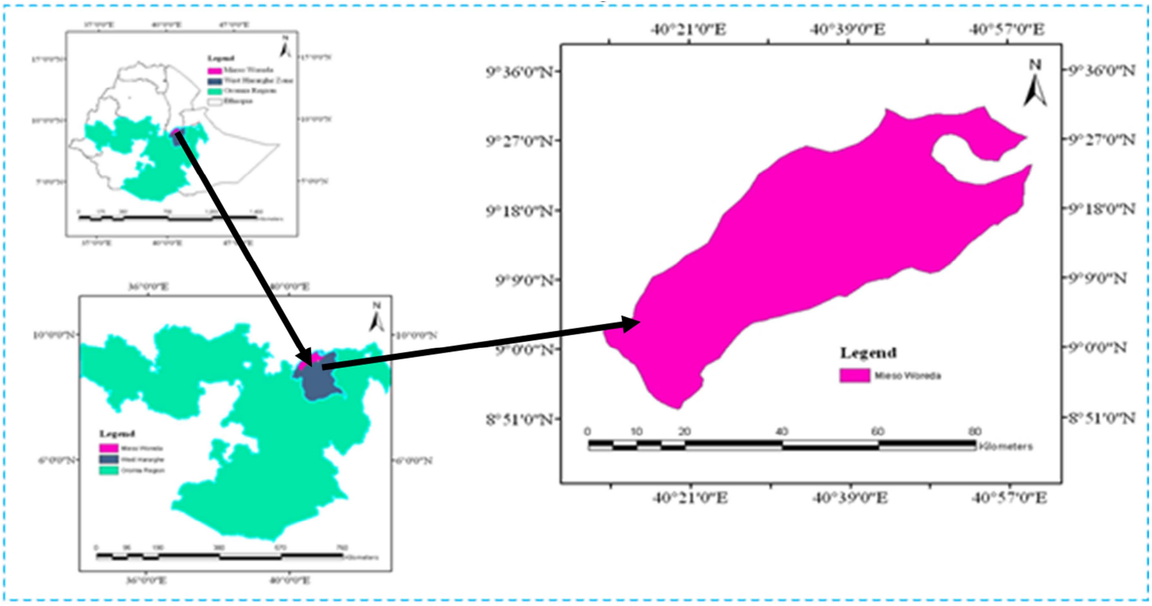


Figure 1. *Map of the study area.*

2.1.2. Altitude and Climate

The district's altitude ranges between 900-1700m.a.s.l., and agro-ecologically classified as lowland with mean annual temperature of 24°C -28°C and mean annual rainfall of 400 to 900mm, with an average of about 790 mm[8]. The area receives a bimodal rainfall where the small rains are between March and April while the main rains are between July and September.

2.1.3. Soil

According to soil classification system (FAO), the major soils of the Study area are Vertic Cambisol (orthic and ferralic), Haplic Luvisol (Orthic) and Eutric Cambisol (Orthic), accounting for 50%, 16% and 11%, respectively [8]. The soil textural classification the study area was clay loam.

2.1.4. Vegetation

Acacia species, Azadirachta indica Adr. Juss, Balanites aegyptica (L.) Del., Delonix elata (L.), GreviIlea robusta A. Cunn. ex R. Br. Gamble, Leucaena leucocephala (Lam.) De Wit, Moringa oleifera Lam., Prosopis juliflora (Sw.) DC., Sesbania sesban are some of the common vegetation type of the study district.

2.1.5. Agriculture

The district has two types of farming systems namely; pastoral and mixed (crop/livestock) farming systems [8]. The Sorghum (*bicolor*), Maize (*Zea maize*), Haricot bean (*Pisum vulgares, Chat (Catha edulis)* are grown in the area in which sorghum covers the majority of the cultivated lands. Also cattle, camel and goat are the dominant livestock in this district. Fattening of large and small ruminants are the main sources of households' livelihood. On the other hand, recurrent drought is common problem of the area that hinders the productivity of crop and livestock, and relief aid is a regular source of livelihood for many rural families.

2.2. Methods

2.2.1. Descriptions of the Studied Trees

Two Peasant associations were purposefully selected based on extensive distribution of *A. tortilis and B. aegyptica* trees on agricultural field. Subsequently, thirty individuals of *A. tortilis and B. aegyptica* trees having approximately similar size and from uniform site condition were marked and numbered from one up to thirty. Of them, four individuals' A. *tortilis and B. aegyptica* trees were selected randomly for this study.

2.2.2. Leaf Sampling and Chemical Analysis

Representative foliar samples from *A. tortilis and B. aegyptica* trees replicated four times in were collected. From each tree, fully mature and expanded green leaves in all compass directions and from different crown positions were collected and evenly mixed to form 1 Kg of fresh leaves per sampled trees. The collected leaf samples were air dried, and after air drying, the leaf samples were oven dried at 80°C till constant weight was achieved. Sampled leaves were ground and analyzed for N, P and K contents following standard methods described by Anderson and Ingram [9].

Moreover, samples of leaf Dry Matter (DM), Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE) and ash were determined according to AOAC [10]. The DM was determined by drying the samples at $80^{\circ}{}_{C}$ till constant weight was achieved. N was determined by micro Kjeldhal method. The %N was used for the estimation of CP. The EE in a sample was determined by extracting with diethyl ether at $60^{\circ}{}_{C}$. For CF, a sample was reflexed first with 1.25% H_2SO_4 and subsequently with 1.25% NaOH for 30 minutes each to dissolve acid and alkali soluble component present in it.

The residue containing CF was dried to a constant weight and the dried residue was ignited in a muffle furnace, then loss of weight on ignition was calculated to express it as CF content. Ash sample was ignited in muffle furnace at $550^{\circ}{}_{C}$ to burn all the OM and the leftover material was weighed as ash. Nitrogen free extract (NFE) was determined on dry matter basis as:

$$NFE = 100 - (\%CP + \%CF + \%EE + \%Ash) \quad (1)$$

Besides, the procedure used by El-Beheiry (2009) was employed for calculation of digestible crude protein (DCP) on DM basis as:

$$\%DCP = 0.929CP\ (\text{in }\%DM) - 3.52 \quad (2)$$

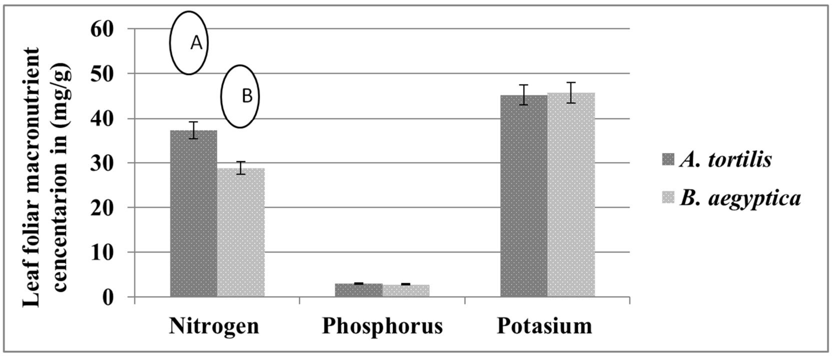
2.2.3. Statistical Analysis

Statistical differences were tested using analysis of variance (ANOVA) following the general linear model (GLM) procedure of SAS Version 9.0 at 5% significant level. Tukey's honest significance difference (HSD) test was used for mean separation for those their analysis of variance showed statistically significant differences ($p < 0.05$).

3. Results and Discussion

3.1. Leaf Macronutrient Concentrations

The leaf foliar macronutrient concentrations of N, P and K of the two species are depicted in Figure 2 below. In the current study, the foliar N concentration of *A. tortilis and B. aegyptica* trees were found to be significantly (P<0.0001).



Bars indicated by letters are statistically significantly different at (p <0.05).

Figure 2. *Mean Values of Leaf Macronutrient as influenced by different tree species.*

The analysis of variance for the foliar macronutrient concentration revealed that the macronutrients elements that form important constituent of plant tissues, foliar concentration (N, P and K) differed between *A. tortilis and B. aegyptica tree species*. Nitrogen, as measure of protein quality and as essential source of feed for microbial growth in the rumen, was significantly affected by *A. tortilis and B. aegyptica tree species.* The average values of nitrogen foliar concentration for *A. tortilis and B. aegyptica* trees were 37.30mg/g & 28.88mg/g respectively. Which means, the leaf foliar nitrogen concentration of *A. tortilis* was significantly higher than the average value for *B. aegyptica* trees.

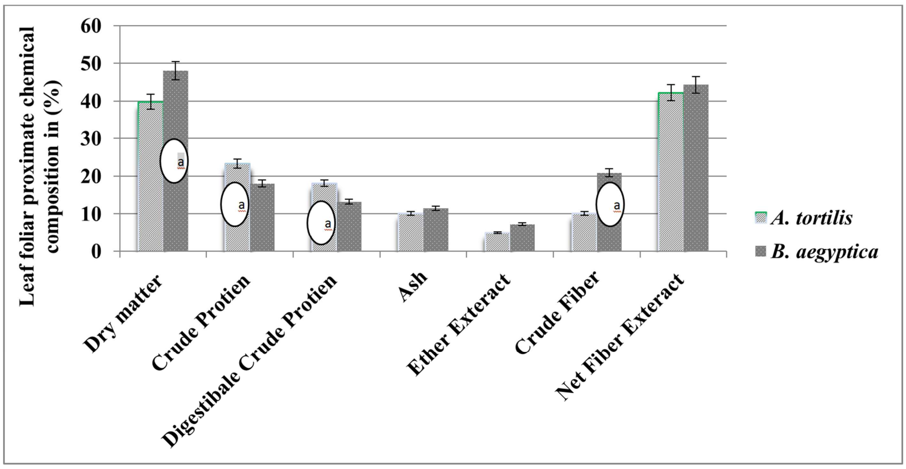
It had been reported by Evans [11] that some tree species have nutrient rich leaves, which readily breakdown and release the nutrients to the organisms body or add to soil fertility. The mean foliar N content of the *A. tortilis* (37.30 mg g^{-1}) and B. *aegyptica* (28.88mg/g) in the current study are above the required level for soil fertility improvement. Palm et al. [12] suggested that organic material with N contents above 25 mg g^{-1} would be considered good quality and suitable as replacement of mineral fertilizer for growth of fodder trees. Net immobilization of N can be expected if the species with N concentration below the critical levels (25 mg g^{-1}) are used as organic fertilizer resources [13]. The average leaf N concentration for *A. tortilis and B. aegyptica* in this study were higher than the average leaf N (21.83 mg g^{-1}) concentration of *F. thonningii* reported by Daniel et al [14] from Tigray and Enideg [15] from Gondar. Furthermore, it was also higher than the foliar N content of *C. africana* and *C. macrostachyus* (12.80 and 12.90 mg g^{-1}, respectively) found by Jiregna et al. [16]. However, the foliar N content of the present study for *B. aegyptica* was lower than those reported by Kindu et al. [13] for *B. polystachya* (36.66 mg g^{-1}), *C. palmensis* (36.50mg g^{-1}), H. abyssinica (30.07 mg g^{-1}) and S. gigas (34.20 1mg g^{-1}). The variation in N concentration among the different species could be ascribed to generic differences of the species, climate, geographical location/agroecology, and time of day, aspect of the tree, tree age, and position of leaves in the crown, age of foliage, internal nutrient balance and effects of diseases [11].

With regard to phosphorus, even though it was not significant, the foliar P concentration was slightly affected by *A. tortilis and B. aegyptica* tree species. The average values of phosphorus foliar concentration for *A. tortilis and B. aegyptica* trees were 2.99mg/g & 2.81mg/g respectively. Even though there was slight variation, the leaf foliar P concentration of *A. tortilis* was significantly higher than the average value for *B. aegyptica* tree. The foliar P content of the present study is within the recommended normal requirement range (1.2 – 4.8 09 mg g^{-1}) of ruminants for normal growth and reproduction [17]. Moreover, the P concentration also met the requirement of P deemed from a quality green biomass 2.5 mg g^{-1} as replacement of inorganic fertilizer suggested by Palm et al. (2001). The average leaf P concentration (2.99mg/g and 2.81mg/g) for *A. tortilis and B. aegyptica* respectively of in the present study were higher than the mean leaf P concentration (2.05 mg g^{-1}) reported from Gondar by Enideg [15]. The foliar P concentration was also higher than that reported for species of *C. africana* and *C. macrostachyus* (1.90 and 2.40 mg g^{-1}, respectively) obtained by Jiregna et al. (2005). However, the foliar P concentration found in this study was lower than those reported for *B. polystachya* (4.71 mg g^{-1}), D. torrida (3.76 mg g^{-1}), H. abyssinica (3.71 mg g^{-1}) and S. gigas (4.75 mg g^{-1}) from Ethiopian highlands [13]. It was also found to be extremely low in the leaves of fodder trees studied, compared to the critical level (7.7 g P/kg DM) suggested by NRC [17].

Even though it was not significant, the foliar K concentration was slightly affected by *A. tortilis and B. aegyptica* tree species. The average values of foliar K concentration for *A. tortilis and B. aegyptica* trees were 45.25mg/g & 45.75mg/g respectively. Even though there was slight variation, the leaf foliar Potassium concentration of *B. aegyptica* was not significantly higher than the average value *for A. tortilis* tree. The mean foliar K concentration (39.95 mg g^{-1}) in the present study was found to be higher than the mean foliar K concentration (9.10 mg g^{-1}) reported by Enideg [15] from Gondar. It was also higher than the foliar K content of *C. africana* and *C. Macrostachyus* (11.5 and 8.70 mg g^{-1}, respectively) than those found by Jiregna et al. [16], and higher than those reported by Kindu et al. [13] for B. polystachya (21.55 mg g^{-1}), C. palmensis (14.93 mg g^{-1}), D. torrid (27.00 mg g^{-1}), and H. abyssinica (21.22 mg g^{-1}), whereas found to be lower than the mean foliar K concentration of S. gigas (55.50 mg g^{-1}) reported by the same authors. With regard to Potassium (K) is an essential element to the growth and developments of an animal according to NRC [17]. Deficiencies in K in cattle can result in reduced intake, weight loss and stiff joints. Cattle stressed due to long transport distances may necessitate increased levels of K to replenish lost body reserve (Ibid).

3.2. Leaf Proximate Chemical Compositions

Results of the analysis of variance for proximate chemical compositions of leaf dry matter (DM), crude protein (CP), digestible crude protein (DCP), ash, ether extract (EE), crude fibre (CF) and nitrogen free extract (NFE) of *A. tortilis and B. aegyptica* trees are presented in Figure 3.



Bars indicated by letters are statistically significantly different at (p <0.05).

Figure 3. *Mean Values of foliar proximate chemical composition as influenced by A. tortilis and B. aegyptica tree.*

Dry Matter (% DM): DM is the actual amount of feed material after removal of water, volatile acids and bases. The leaves dry matter contents (% DM) of *A. tortilis and B. aegyptica* trees were significantly (P<0.0001) different (Figure 3). The average values of leaf dry matter for *A. tortilis and B. aegyptica* trees were 39.81% & 48.08%

respectively. In this study, the leaf dry matter content of *A. tortilis* was statistically significantly lower than the average value for leaf dry matter content of *B. aegyptica* trees. Reported values of Dry matter for those current experimental tree species and other tree species are differed. For instance, lower values (21.63 and 40.61 %) of *F. thonningii* than the present study were reported by Ogunbosoye and Babayemi [18] and Tegbe *et al.* [19] respectively. Likewise Ojokuku et al. [20] reported lower value of DM (19.8%) for *F. capensis* while Nkafamiya *et al.* [21] found lower values (19.01%, 14.12%) for *F. asperifolia* and *F. sycomorus*, respectively and Daniel et al. [14] for *Ficus polita* (30.40%). On the contrary, Azim *et al.* [22] found higher value (50.5%) for *F. religiosa*.

Crude Protein (% CP) was found to be significantly varied between the species studied. Crude protein is an important requirement to support optimum microbial growth of rumen. The leaf proximate chemical composition %CP of *A. tortilis and B. aegyptica* trees showed significant differences (P<0.0001) (Figure 3). The average values of %CP for *A. tortilis and B. aegyptica* trees were 23.3% & 18.05% respectively. The average value of crude protein for *A. tortilis* statistically significantly higher than the average value of % crude protein of *B. aegyptica* tree. The mean CP of the present study by far exceeds the minimum protein requirements of ruminants 7%, below which the feed intake might be depressed as it is not sufficient to meet the needs of the rumen bacteria [17]. Comparing the CP of the current study (23.3% and 18.05%) for *A. tortilis and B. aegyptica* trees respectively were higher than other research result reported for *F. thonninigii* [23]. Other results on Ficus species also revealed substantial difference. While higher (20.27%) and comparable (17.24%) values of crude protein were reported for species of *F. asperifolia* and *F. sycomorus* respectively [20, 21]. However, Azim *et al*. [23] and Daniel and Agena [24] found lower (3.63%, 11.7% and 15.70%, respectively) CP value for *F. capensis*, *F. religiosa* and *F. polita*. The substantial variation between the different browse tree species could be genetic whereas the variation within species could be ascribed to climate or season, geographical location or agroecology, time of day, aspect of the tree, tree age, and position of leaves in the crown, age of foliage, internal nutrient balance, and effects of diseases, soil type and age.

Digestible crude protein (% DCP): The leaf digestible crude protein (% DCP) of *A. tortilis and B. aegyptica* trees showed significant difference (P<0.0001) with the average values of 18.14% & 13.25% respectively (Figure 3). In this case, the average value of percent digestible crude protein for *A. tortilis was* statistically significantly higher than the average value of percent digestible crude protein of *B. aegyptica* tree.

Ash (%): The mean values of leaf ash content of *A. tortilis and B. aegyptica* trees did not show significant variation (P<0.063). The average values of leaf ash content of for *A. tortilis and B. aegyptica* trees were 10.18% & 11.47% respectively (Figure 3). Although the average values of leaf foliar concentration of ash was not significant, the average value of *A. tortilis was slightly lower than the average value of* B. *aegyptica* trees.

Ether Extract (% EE): No significant variation was shown in the mean values of leaf Ether Extract (% EE) content of *A. tortilis and B. aegyptica* trees (P<0.063). The average values of leaf ash content of for *A. tortilis* and *B. aegyptica* trees were 5.01% & 7.25% respectively (Figure 3). Although the average values of leaf foliar concentration of Ether Extract was not significant, the average value of *A. tortilis* was slightly lower than the average value of *B. aegyptica* trees.

Crude Fibre%: The leaves Crude Fibre contents (% CF) of *A. tortilis and B. aegyptica* trees were revealed statistically significant (P<0.0002) differences between the species. The average values of leaf crude fibre for *A. tortilis and B. aegyptica* trees were 10.12% & 20.89% respectively. In this study, the leaf crude fibre content of *A. tortilis* was statistically significantly lower than the average leaf crude fibre content of *B. aegyptica* trees.

Nitrogen Free Extract (%NFE): The mean values of leaf nitrogen free extract (% NFE) content of *A. tortilis and B. aegyptica* trees were not showed significant variation (P<0.063) between species. The average mean values of leaf nitrogen free extract content of *A. tortilis and B. aegyptica* trees were 42.25% & 44.35% respectively. Although the leaf foliar concentration of nitrogen free extract was not statistically significant the two species, the average value for *A. tortilis was slightly lower than the average value for* B. *aegyptica* trees. The variation in DM composition of the different browse might be due to the generic differences, climate or season, geographical location or agroecology, time of day, aspect of the tree, tree age, and position of leaves in the crown, age of foliage, internal nutrient balance, effects of diseases, soil type and soil age.

4. Conclusion and Recommendation

Among the leaf foliar macronutrients considered in this study, the leaf foliar nitrogen concentration of *A. tortilis* was statistical significantly higher than *B. aegyptica.* With the regard to proximate chemical composition, dry matte, crude protein, digestible crude protein and crude fiber were also revealed statistical significant variation between the two species. Tree phenology is different in different season thus its nutritional quality may be different for different season and age. Therefore, further study will be important to know the effect of this tree on microclimatic factors under its canopy in different seasons. Because of its role in ameliorating microclimate and improving soil fertility under its canopy, retaining of *A. tortilis and B. aegyptica* trees on crop land is important for the farmers with appropriate component management like lopping and crown opening.

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References

[1] Akinbile, C. O., A. Y. Sangodoyin, I. Akintayo, F. E. Nwilene, and F. Nwilene. 2007. Growth and Yield Responses of Upland Rice (NERICA) under Different Water Regimes in Ibadan, Nigeria. Research Journal of Agronomy, 1 (2): 71-75.

[2] D. P. Garrity. 2004. Agroforestry and the achievement of the Millennium Development Goals. Agroforestry Systems 61: 5-17. DOI: 10.1007/978-94-017-2424-1_1.

[3] Nair, 1993. An Introduction to Agroforestry. Kluwer Academic Publishers in collaboration with International Centre for Research in Agroforestry. ISBN 0-7923-2134-0. http://www.worldagroforestry.org/units/library/books/PDFs/32_An_introduction_to_

[4] Young, A., 1997. Agroforestry for Soil Management, (2nded). CAB International, Wallingford, UK. www.cabdirect.org

[5] Rao, M. R., Nair, P. K. R. and Ong, C. K., 1998. Biophysical Interactions in Tropical Agroforestry Systems. Journal of Agroforestry system 38: 3-50. DOI: 10.1023/A:1005971525590.

[6] MONTEITH, J. L.; ONG, C. K.; CORLETT, J. E. 1991. Microclimatic interactions in agroforestry systems. Forest Ecology and Management, v. 45, n. 1, p. 31-44.

[7] Zebene Asfaw and Ågren, G., 2007. Farmers' Local Knowledge and Top soil Properties of Agroforestry Practices in Sidama, Southern Ethiopia. Journal of Agroforest Systems, 71: 35-48. DOI: 10.1007/s10457-007-9087-0.

[8] IPMS (Improving Productivity and Market Success of Ethiopian Farmers), 2006. Pilot Researching Site of MiesoWoreda. IPMS, Addis Ababa, Ethiopia. http//www. IPMS-Ethiopia.org.

[9] Anderson J. M. and Ingram J. S. I., 1993. Tropical soil biology and fertility: a handbook of methods. Second edition. CAB International, The Cambrian News, Aberstwyth, United Kingdom. 221 p. DOI: https://doi.org/10.1017/S0014479700024832

[10] AOAC. (1990). Official methods of analysis of the AOAC, 15th ed. Methods 932.06, 925.09, 985.29, 923.03. Association of official analytical chemists. Arlington, VA, USA.

[11] Evans, J. 1982. Plantation Forestry in the Tropics. Oxford, UK: Clarendon Press. DOI: https://doi.org/10.1017/S0014479700022687

[12] Cheryl A. Palma, Catherine N. Gachengoa, Robert J. Delvea, b, Georg Cadischc, Ken E. Gillerc. 2001. Organic inputs for soil fertility management in tropical agroecosystems: application of an organic resource database. Agriculture, Ecosystems and Environment 83 (2001) 27–42. https://doi.org/10.1016/S0167-8809(00)00267-X

[13] Kindu M, G Glatzel, Tadesse Y, and Yosef A. 2006. Tree species screened on Nitisols of central Ethiopia: biomass production, nutrient contents and effect on soil nitrogen. Journal of Tropical Forest Science 18: 173-180. Corpus ID: 85597836.

[14] Daniel Hagos Berhe, Agena Anjulo, Abdu Abdelkadir and Sue Edwards. 2013. Evaluation of the effect of *Ficus thonningii* (blume) on soil physicochemical properties in Ahferom district of Tigray, Ethiopia. *Journal of Soil Science and Environmental Management.* Vol. 4 (2), pp. 35-45. DOI 10.5897/JSSEM12.0369.

[15] Enideg Diress, 2008. Importance of *Ficus thonningii* Blume in Soil Fertility Improvement and Animal Nutrition in Gondar Zuria, Ethiopia. M.Sc. Thesis, University of Natural Resources and Applied Life Science, Vienna.

[16] Jiregna Gindaba, Rozanov, A. and Legesse Negash. 2005. Trees on Farms and Their Contribution to Soil Fertility Parameters In Badessa, Eastern Ethiopia. Journal of BiolFertil Soils, 42: 66-71. DOI: 10.1007/s00374-005-0859-2.

[17] NRC (National Research Council). 1980. Mineral Tolerance of Domestic Animals. Washington, D. C.: National Academy Press. https://doi.org/10.17226/25.

[18] Ogunbosoye and Babayemi. 2010. Potential values of some non-leguminous browse plants as dry season feed for ruminants in Nigeria. African Journal of Biotechnology Vol. 9 (18), pp. 2720-2726. http://www.academicjournals.org/AJB. DOI: 10.5897/AJB09.1782.

[19] Tegbe T. S. B, Isaac Adetunji Adeyinka, Baye K. D, Alawa J. P. 2006. Pakistan Journal of Nutrition 5 (6). DOI: 10.3923/pjn.2006.548.550.

[20] Sikiru Abiola Ojokuku, Wahab Okunowo, Akinkunmi Akinkunmi. 2010. Evaluation of the chemical composition of *Khaya grandifoliola* and *Ficus capensis*. Journal of medicinal plant research 4 (12): 1126-1129. DOI: 10.5897/JMPR10.220.

[21] Iliya I Nkafamiya, S. A. Osemeahon, U U Modibbo, A Aminu. 2010. Nutritional status of non-conventional leafy vegetables, *Ficus asperifolia* and *Ficus sycomorus.* African Journal of Food Science Vol. 4 (3) pp. 104-10. http://www.academicjournals.org/ajfs

[22] Azim, A., Ghazanfar, S., Latif, A. & Nadeem, M. A. 2011. Nutritional Evaluation of Some Top Fodder Tree Leaves and Shrubs of District Chakwal, Pakistan in Relation to Ruminants Requirements. Pakistan Journal of Nutrition 10 (1): 54-59. DOI: 10.3923/pjn.2011.54.59.

[23] Taye O Abegunde, O. J. Babayemi. Akinsoyinu A. O. 2011. Nutritive Value Assessment of Ficus polita and Panicum maximum at Varying Proportions Using an in vitro Gas Production Method in the Dry and Wet Seasons. Pakistan Journal of Nutrition 10 (1). DOI: 10.3923/pjn.2011.35.39.

[24] Daniel Hagos Berhe Agena Anjulo Tanga. 2013. Nutritional evaluation of *Ficus thonningii* Blume leaves as ruminant livestock feed in the Ahferom district of Tigray, Ethiopia. African Journal of Range and Forage Science 30 (3) DOI: 10.2989/10220119.2013.765505.