Effects of Leucaena Leucocephala and Dactyladesa Barteri on the Yield of cassava (Manihot Utilicima) In the First and Second Year Farming Seasons

By

Ndelekwute, Stanislaus C

Abstract

A study was conducted in the Teaching and Research Farm of the Department of forestry and Environmental Management, Michael Okpara University of Agriculture, Umudike, for two consecutive cropping seasons in 2010 and 2011. Leucaena leucocephala and Dactyladesa barteri were inter-cropped with Manihot utilictma (cassava) to investigate the influence of the leguminous trees on the cassava yield in the first and second year farming. Randomized Complete Block Design was used. Data collected were subjected to analysis of variance at 5% probability level. The result showed that in the first year of planting, the cassava yield was not significant, but during the second year the yield was statisticauy significant and even better than the previous year. The yield of cassava planted in Leucaena alleys was higher than those in the Dactyladesa alleys and both Leucaena leucocephala and Dactyladesa barteri can improve the yield of cassava by enhancing the nutrient status of soils.

INTRODUCTION

Since ages, the incorporation o~ trees in traditional agricultural land has helped in enhancing ~e soil productivity and increasing crop yield (Udofia, 2001;) Olujobi and Oke, 2005). One of the methods of managing tees in agricultural land is shifting cultivation which allows ush Fallow. Bush fallow is a major practice in the Shifting\6ultivation' system with the aim of restoring soil productivity and maintaining soil fertility through the availability of nitrogen-fixing trees and shrubs. Variants of shifting cultivation are viable systems of land management and are generally preferred by rural farmers when compared with modern agricultural systems that depend on high inputs (Allen, 1999; Clark, 1976; Grandstaff, 1978).

The increasing population rate has brought about land scarcity and thus has ultimately shortened or completely ruled out the fallow, period in some farming communities. The objectives of bush fallowing have therefore, been defeated because of repeated cropping on the same unit of land. The continuous, farming declines soil fertility and results in poor crop yields. The consequence is that food production is on negative correlation with increasing population rate. Of recent, scientists have found that to alleviate the problem of food shortage, interest has to be geared in the development and use of more productive land-use technology involving intercropping of leguminous tree species with food crops in agro-forestry-system (Sanchez, 1987).

One of such technologies is alley cropping in which food crops are intercropped with selected shrubs planted in managed hedgerows at desirable interrow spacing, 101-nutrient recycling and provision of organic matter. This is an improved bush fallow system that allows the simultaneous use of the land for crops and fallow (Wilson and Kang, 1981; Gelahum et al, 1987).

As in the case of the traditional bush fallow system, improvements in the soil physical and chemical properties are involved. In the alley cropping system, the increasing hedgerow biomass production that constitutes the organic matter also enhances the rapid soil nutrient status. The objectives of this research therefore, were to assess the soil nutrients as influenced by the hedgerows and also the crop yield and height growth.

MATERIALS AND METHODS

A field trial was carried out in the Teaching and Research Farm of the Department of Forestry and Environmental management, Michael Okpara University of Agriculture, Umudike, in 2010 and 2011,Umudike lies within latitude 05° 29 North and longitude 07° 33 East. Rainfall ranges from 1500mm to 3000mm per annum. The rains begin in March and continue till October, with peaks in June and September. The dry season starts from November and extends to February with temperature varying between 22.48°c and 30.12°c (NRCRI, Unpublished).

The site was ploughed and harrowed in February 2010. Soil analysis was carried out. The experimental area measured 19m x 22m, equivalent of 0.04 hectare. It was demarcated into four blocks. The materials were Leucaena leucocephala, Dactyladesa barteri and Manihort utilicima.

The leguminous trees were spaced at 4m x1m and had an equivalent stocking of2500 plants per hectare; cassava was spaced at 1 m x 1 m, which gave a population density of 10,000 plants per hectare.

In 2011 another set of cassava was planted with the same espacement in the alleys, and also on the replicate having sole cassava, Leucaena leucocephala, Dactyladesa-cassava.

Soil data were collected in 2010 and 20 11 from 0-1 Ocm and 10- 20cm depths with the use of soil auger, in sixteen randomly selected points in each block. The sample dried on a table and analysed in the soil laboratory of the Michael Okpara University of Agriculture, Umudike, for organic matter content (%), pH and nutrient status: Total N (%), available P and Ca, Mg (Cmol Kg^{-1}) as described by Walkey and Black(1934), Bates(1954), Jackson(1962) respectively.

Other parameters measured were cassava tuber yield, height and leguminous leaf biomass yield and nutrients. The data collected were subjected to analysis of variance. The means of each set of data were compared using the Fishers Least Significant Difference (LSD) method at 5% probability level.

RESULTS AND DISCUSSION

The effects of leguminous tree species on cassava height at 12 months after planting (12MAP) are presented on Table 1. It was observed that the cassava height in the alleys of Leucaena have higher values than the cassava planted on the alleys of Dactyladesa barteri and in control (without legumes) plots. Table 2 explains that cassava heights on alleys of Leucaena and Dactyladesa were higher than those in the control plots and even higher than those planted in the first year.

Cassava tuber yields planted in mixture with Leucaena had higher yield values than Dactyladesa-Cassava and control plots, but there was no statistical significant difference between them (table 1). In table 2, there was a significant difference between the tubers in the three treatments. Dry matter production increased from 13 to 24 MAP (table 3). Effects of leguminous tree species on soil nutrient status at 12 and 24 MAP are shown on tables 4 and 5 respectively. The results of analysis of the soil showed a lower level of nutrients in table 4'than in table 5. In the second year planting the organic matter (table 5) in the soil of the study site was generally high with 3.45 per cent for the hedgerow plots and 1.76 per cent for plots without hedgerows.

The cassava yield was significantly influenced by the leguminous tree species than in the control (no leguminous tree) treatment. The least value in the control plots indicated that the cassava diminished the soil fertility because neither fertilizers nor prunings from the leguminous trees were added to replace the soil nutrients already utilized by the cassava. This result has shown that improved soil nutrient status has influenced the higher yield of food crop in the alleys of leguminous trees. This result is consistent with Kang et ale 1990) who observed that leaf litter and pruning from hedgerows provided large amount of organic matter increased nutrient levels, thus corroborating the result ofthis research. Palada et al (1992) in their study on alley cropping with Leucaena leucocephala obtained a result similar to those reported in the study. They found that crop yields were substantially increased by the application of Leucaena pruning. There is an indication that the crop roots laid on the upper layer where pruning had been incorporated in the soil, thereby depleting the soil nutrients they would require from this layer in subsequent cropping. The results of this study (tables 4 and 5) support findings ofKang et al (1990) who found that leguminous hedgerow pruning constitute soil organic matter and enhanced increased food yield in an agro- forestry system. The study has further revealed the significant positive contributions of leguminous tree species on the cassava yield. Cassava production can therefore, be improved if inter- planted with leguminous trees.

Table 1: Effects of Leguminous Tree Species on Cassava Tuber yield and related yield Characters at 12 MAP

Treatment	Tuber yield tons/ha	Top yield tons/ha	Harvest index	Branching height (cm)/stand	Leaf area (cm^2)
Control	7.28	5.62	0.35	9.41	2.2
Leucaena	12.8	10.35	0.042	12.35	3.9
Dactyladesa	10.32	8.13	0.38	10.98	2.8
LSD	3.12	2.95	0.42	2.1	1.7

Source: Field Survey (2010 and 2011) LSD =Least Significant Difference

Table 2: Effects of Leguminous Tree Species on Cassava Tuber yield and related yield Characters at 24 MAP

Treatment	Tuber yield tons/ha	Top yield tons/ha	Harvest index	Branching height (cm)/stand	Leaf area (cm^2)
Control	6.89	4.95	0.31	9.62	2.4
Leucaena	16.61	12.32	0.53	14.39	4.2
Dactyladesa	12.81	9.45	0.47	11.75	3.5
LSD	3.62	2.86	0.02	1.31	0.8

Table 3 Dry matter production (kg/tree) of the Hedgerow species from pruning in the second farming

Hedgerow species	**Biomass**
	13 MAP
Leucaena	12.56
Dactyladesa	10.13
	18 MAP
Leucaena	14.64
Dactyladesa	11.92
	24 MAP
Leucaena	14.64
Dactyladesa	11.92
LSD	2.1

Source: Field survey (2010 and 2011)

Table 4: Effects of Leguminous Tree species on Soil Nutrient status at 12MAP Hedgerows

Treat-ment	**Soil depth (cm)**	**pH**	**O.M (%)**	**Total N (%)**	**Avail. P (mg/kg)**	**Ca (cmol/kg)**	**Mg (cmol/kg)**	**Sa Na (cmol/kg)**	**Si K (cmol/kg)**	**Cl**	**Texture**		
Contr.	0-10	5.62	1.90	0.06	58.49	1.19	0.86	0.03	0.5	84.12	7.13	8.75	SL
	10-20	5.53	1.10	0.04	51.62	1.30	0.61	0.02	0.3	69.8	8.09	22.1	SL
Leuc.	0-10	4.92	3.10	0.19	78.52	2.46	1.33	0.07	0.12	13.16	14.54	12.3	SL
	10-20	4.80	2.00	0.08	69.88	2.18	1.10	0.06	0.13	52.13	21.21	26.21	SL
Dact.	0-10	5.10	2.92	0.16	70.11	1.95	1.14	0.05	0.08	71.12	18.65	10.23	SL
	10-20	4.85	2.20	0.00	61.22	1.62	1.01	0.04	0.00	61.13	13.58	25.29	SL

Source: Field survey (2010 and 2011). O. M = Organic Matter, Sa =Sand, Si =Silt, Cl =Clay, SL =Sandy loam

Table 5: Effects of Leguminous Tree species on Soil Nutrient status at 24 MAP Hedgerows

Treat-ment	**Soil depth (cm)**	**pH**	**O.M (%)**	**Total N (%)**	**Avail. P (mg/kg)**	**Ca (cmol/kg)**	**Mg (cmol/kg)**	**Sa Na (cmol/kg)**	**Si K (cmol/kg)**	**Cl**	**Texture**		
Contr.	0-10	5.81	1.76	0.05	55.35	1.48	0.79	0.03	0.3	84.92	7.27	7.81	SL
	10-20	5.62	1.72	0.03	49.42	1.37	0.58	0.03	0.2	76.00	10.79	13.21	SL
Leuc.	0-10	4.10	3.45	0.23	82.35	2.65	1.38	0.09	0.16	69.12	12.78	18.10	SL

	10-20	4.25	3.10	0.19	73.61	2.35	1.25	0.07	0.11	56.62	21.92	21.16	SL
Dact.	0-10	5.16	3.10	0.16	75.31	2.45	1.30	0.06	0.10	73.12	13.48	13.40	SL
	10-20	4.19	2.90	0.11	70.29	2.25	1.28	0.06	0.09	65.51	20.21	14.25	SL

CONCLUSION

The study has shown that alley cropping offers a promising result for sustained crop production. This could be achieved by incorporating pruned materials from hedgerows into the soil, which would aid in the recycling of nutrients in layers of the soil to improve the soil structure and moisture content. Based on the result of this research, it is recommended that farmers should be encouraged to plant leguminous tree species such as Leucaena leucocephala and Dactyladesa barteri in their farms and spread the pruning of such leguminous trees during cropping period on the farms in order to. enhance sustained soil nutrient recycling status. The consequence of the practice is to achieve improvement in farm productivity to boost food yields, which is the ultimate goal of every farmer.

REFERENCES

Allen, B. 1. (1999). *Dynamics of Fallow Successions and Introduction of Robusta Coffee in Shifting Cultivation Areas in the Lowlands of Papua New Guinea.* In Nair,P.K.R. (ed.) *Agro-forestry Systems in the Tropics*. Kluwer Academic Publishers. Dordrecht, the Netherlands, 277-290 pp.

Bates, R .G. (1954). *Electronic pH Determination.* New York: John Wiley and Sons Inc. Clark, W. C. (1976). The Maintenance of Agriculture and Human Habitats within the Tropical Forest System. Human Ecology, 4: 247-259.

Gelahum, A., Wilson, G. F. And Kang, B. T. (1987). *Role of Trees in Farming System in the Humid Tropics.* In MacDonald, L. H. (ed.). *Agro-forestry in the African Humid Tropics.* The United Nations University. Tokyo, Japan, 28-35pp.

Grandstaff, T. (1978). *The Development of Swiden Agriculture (Shifting Cultivation). Development and Change*, 9(4): 547-579.

Jackson, M. C. (1962). Soil Chemical Analysis. Prentice Hall Inc. Eaglewood Cliffs.

Kang,B. T., Reynolds, 1. And Attah,K. (1990). *A Preliminary Study of Effects of Leucaena leucocephala,* Gliricidia sepium and Acacia auriculiformis on the Yields of Food Crops under Agro-forestry System in Uyo. *Nigerian Journal of Agric. Technology,* 7: 60-67. NRCRI Unpublished. Meteorological data in Abia State, Nigeria. Unpublished Report of the Meteorological Unit, National Root Crops Research Institute, (NRCRI) Umudike, Nigeria.

Olujiobi, O. J. and Oke, D.O. (2005). *Assessment of existing Agro-forestry practices in Ondo State, Nigeria.* In Popoola, L., Mfon, P. And Oni, P. 1.

(eds*). Sustainable Forest Management in Nigeria: Lessons and Prospects.* Forestry Association of Nigeria. Nigeria: Hedimo Prints, 110-117 pp

Palada, M, c., Kang, B. T. and Classen, S. L. (1992). *Effects of Alley Cropping with Leucaena leucocephala and Fertilizer Application on field of Vegetable Crops, Agro- forestry Systems*, 19: 139- 147.

Sanchez, P. A. (1987). *Soil Productivity and Sustainability in Agro-forestry Systems,* In Steppler, H. A. And Nair, P. K. R. (eds). *Agro-forestry: A Decade of Development.* ICRAF, Nairobi, Kenya, 205-220pp.

Wilkey, A. and Black, L. A. (1934). Soil Science, 37: 9-38. Udofia, S. I. (2001). *The Role of Agro-forestry practices in checking Environmental Degradation.* In Udo, E. S. (ed). *Forestry and Sustainable environment.* Eubinis (Nig.) Ltd Uyo, Akwa Ibom State, Nigeria, 122- 131.

Wilson, G. F. and Kang, B.T. (1981). *Developing stable and Productivity Biological Degradation Cropping Systems for the Humid Tropics.* In Stoneshouse, B. (ed). *Biological Husbandry. A Scientific Approach to Organic Farming*. London: Butterworth, 193-203pp.