



Impact of Albizia Lebbeck Benth (Ratle Tree) on Soil Nutrient Status and Crop Yield Under Agroforestry System (Alley Cropping)

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ABSTRACT

This experiment was conducted to evaluate the impact of Albizia lebbeck Benth (its green manure and N₂ fixing ability of its tree rows) on soil nutrient status (physical and chemical properties) under alley cropping (an agro-forestry system) with Irish potato (*Solanum tuberosum* L.). The experimental design was a randomized complete block design (RCBD) comprising five treatments and three replicates. Soil sample analyses (pre and post experiment) were done. Tending operations and data collection on apparent growth and yield parameters throughout the five cropping seasons were carried out. Results on the soil physical properties indicated that the nine (9) samples from the three soil depths of T4 were predominantly sandy loam (except two samples) probably because T4 received the highest rate of green manure application (10 ton ha⁻¹) and also had A, lebbeck tree rows. This had increased the ratio of smooth to coarse fragment in favor of smooth. T1, T2 and T3 had three (3) of their replicates (samples) being sandy clay loam as opposed to T4 with only two (2). Though T0 also had only two of its nine samples being sandy clay loam which could be attributed to the initial textural class of T0 (T0 being the control experiment). Thus, a little /non-significant difference between the pre and post planting soil texture was observed. This is probably the reason why analysis of variance on the clay content indicated no significant difference in the soil texture before and after planting and all the textural classes were mainly loamy textured with sandy clay loam, clay loam and sandy loam constituting the dominant textural classes. Regarding the soil chemical properties, the organic matter and nitrogen were very low and the values decreased from pre planting to after planting (no significant difference between treatments /blocks) probably due to crop removal, leaching and high rates of decomposition/mineralization but the treatments applied (A. lebbeck green manure and its tree rows) significantly influenced the available P at 0 – 10 cm depth and K at three soil depths. Block effects were observed at significant level on the pH at 10 – 25 cm and 25 – 40 cm depths and on Mg at 0 – 10 cm depth. The available P decreased generally from the surface soil (down wards) to the subsoil in the study site owing to absorption by the plants and crop removal. The values of exchangeable acidity and effective cation exchange capacity increased generally from surface soil to the sub-soil probably due to leaching or infiltration of the exchangeable cations. The apparent growth parameters (plant height, leaf count and collar girth) except stem count were highly influenced by the different levels of Albizia lebbeck green manure application and its tree rows (sequel to N₂-fixation) at P < 0.1 which subsequently brought about significant differences in yield (tuber count (P < 0.5) and tuber weight (P < 0.01).of the crop (Irish potato) in all the 5 treatments and throughout the 5 cropping seasons due to modification/improvement on the soil physical and chemical properties/nutrient status in the agro-forestry farm.

Keywords: Impact, nutrient status, Soil physical and chemical properties, Albizia lebbeck, agro-forestry, crop yield.

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1. INTRODUCTION

The essence of improving the nutrient status of our impoverished soils cannot be overemphasized. The organic matter content on the soil surface is being destroyed by wildfire/bush burning in the forest and savanna ecosystems annually (Okonkwo and Kareem, 1999) coupled with the consumption of much of the organic matter by termites most especially in the semi-arid areas (Gachene and Kimaru, 2003). Even, the nitrogen that is abundantly available in the atmosphere (about 79%) is very deficient in most soils.

Several tons of chemical (nitrogenous) fertilizers are purchased yearly to remedy soil nitrogen deficiencies and besides its exorbitance, its application could adversely affect the ozone layer thereby causing increase in skin cancer and rates of mutation in organisms due to harmful radiation (Alexander, 1982). Integration of non-nitrogen and nitrogen fixing trees into agro-forestry systems has been identified as one of the ways of increasing the organic matter and nitrogen content in most savanna soils. These are the soils which Alasiri (1997) described as being low in nutrients and of poor structure due to continuous cultivation. In soil fertility improvement and land reclamation, nitrogen fixing trees can play significant roles particularly under alley cropping system which has been known to enhance both nutrient and structural characteristics of soils (Osunde, 1995).

Most tropical soils are highly weathered and leached, some of which are typical Ultisols that are usually characterized by low levels of organic matter and nitrogen content of about 0.3 – 0.6% and 0.03 – 0.05% respectively (D'Hoore, 1964). In the past, organic matter build-up was achieved under bush fallow system or shifting cultivation or land rotation as a means of fertility maintenance (Greenland and Nye, 1959). But owing to rapidly increasing population, these systems are no more practicable due to pressure on land by other sectors of the economy (Yayock et. al., 1988). The vital role played by organic matter in the soil cannot be over-emphasized as Nye (1961) had earlier described it as a vital component of soil exchange complex. This can be increased through ample supply of organic residues such as litter and compost. These inputs can be achieved under alley cropping with trees that are characterized by profuse litter deposition and nitrogen fixing capacity especially in the long run sustainably.

Also, Adepetu et. al. (1979) reported a 58% drop in the organic matter content of the low soil series in a virgin forest site at Ile-Ife, South Western Nigeria during a seven-year continuous cropping. High cost and inadequate supply of inorganic fertilizer at the right time are among the major constraints to sustainable soil management and cropping and even some of the available ones are adulterated. The use of farmyard manure is limited to small area of land since the demand by large scale farmers or the numerous small scale farmers cannot be met owing to major constraints such as unavailability/scarcity or insufficient quantities of animal wastes, transportation and labor costs (Yayock et al., 1988).

An alternative and inexpensive technique of improving soil nutrient status is alley cropping (an agro-forestry system), where trees help in improving soil fertility (Famuyide and Kareem, 2006). Also, greater erosion resistance, litter deposition, better microclimate and improved rate of mineralization are feasible. Under alley cropping farm, effective timing of nutrient release through decision on when to prune the hedge or tree rows for mulching or as green manure is easily determined (Young, 1985; Adebago, 1997) in addition to N₂ fixation activities. Saginga and Mulongoy (1995) reported that more than 3000 kg N ha⁻¹ yr⁻¹ was realized when

Gliricidia /*Leucaena* hedge rows were pruned and their nitrogen content in the range of 40 – 70 kgNha⁻¹ per season was released to crops. With *Albizia lebbek* which is capable of fixing high amount of nitrogen (Dommergues, 1987) because most soils in the tropics harbor the *Bradyrhizobium* strains of nitrogen fixing bacteria needed for nodulation which is present in this species (*Albizia lebbek*).

Coupled with its profuse litter deposition in the dry season (being deciduous) the soil physical and chemical properties are eventually modified thereby leading to higher nutrient status. The objective of this study is to evaluate the impact of *Albizia lebbek* on the soil nutrient status (physical and chemical properties) and potato (*Solanum tuberosum*) yield under agro-forestry.



2. MATERIALS AND METHOD

2.1 The Study Area

The experiment was carried out in the Teaching and Research Farm of the Department of Agricultural Extension and Management, Federal College of Forestry, Bauchi Road, Jos, Plateau State, Nigeria in the north-eastern part of the Jos city. The Jos Plateau is located in the Northern Guinea Savanna but owing to its distinctive features, it has been mapped out separately from the rest of the Northern Guinea Savanna Zone (Keay, 1959). The Jos Plateau lies between latitude 8° 50'N and 10° 10'N and longitude 8° 22'E and 9° 30'E (Udo, 1978). The average elevation is about 1250 meters above sea level while its height above the surrounding plains is about 600 m and the highest point is about 1777 meters above mean sea level which is about 20 km eastwards from Shere Hill. Also, a number of relatively low plains are found at the boundaries of the Jos Plateau, at the north-east, it is surrounded by the Bauchi plains, Jama' Kaduna plains to the north-west and the Benue lowlands to the South. The Jos Plateau is about 8,600 km², its north to south length is about 105 km and 81 km from east to west and almost occupies the center of the Nigeria's physical space (Keay, 1951; Keay, 1959; Hill, 1978; Davis, 1973; Morgan, 1979; Eziashi, 1995).

2.2 Pre-Experimental Soil Analysis

In order to assess the initial nutrient status of the experimental site and use the result of the laboratory analysis as basis for the block design, soil nutrient analysis was carried out. Prior to blocking of the experimental site into three parts to represent the three blocks, three portions or locations were randomly selected (as major locations/portions). This was followed by random selection of four sub-locations from each major location. Subsequently, from each sub-location, soil samples were collected at three depths: 0-10, 10-25, and 25-40 (cm). Composite samples from each major location were used for analysis (that is, the three major locations were assigned Arabic numerals 1, 2, and 3, their corresponding sub-locations were 1a, 1b, 1c, 1d; 2a, 2b, 2c, 2d; 3a, 3b, 3c, 3d). Each sub-location was at 3 soil depths represented in Roman numerals i, ii, and iii. To make composite samples, combinations of ai, + bi + ci, di; aii + bii + cii, dii and aiii + biii + ciii, diii were produced). Thus, a total number of 9 samples (3 from each of the major locations) were analyzed and taken as pre-experimental site nutrient status (Table 1 and 2). Furthermore, each sample was meticulously put in polythene bags separately, labeled and taken to the laboratory, removed from the polythene bags, air dried, ground, sieved with 2 mm sieve, smooth and coarse

samples weighed separately, the percentage of the coarse portion determined and smooth portion subjected to laboratory analysis. Also, a soil profile was dug at a suitable place in the experiment site. This paved way to have the knowledge of the different horizons in the soil profile, ensured proper identification and classification of the different soil types (for example, Entisols, Inceptisols, Alfisols and Ultisols). It is pertinent to mention here that the same soil sample analytical procedures were employed before (pre) and after (post) the experiment. Determination of the particle size distribution of the soil samples was done by using the hydrometer method (Day, 1965) and separated into sand, silt and clay and expressed in percentages, while the pH (1:2.5) in water and KCl was determined electronically by using a functional pH meter. Flame photometer was employed in the determination of the exchangeable cations (bases) such as Na and K while estimation of the Ca, Mg was done by means of atomic absorption spectrometer (AAS). Effective cation exchange capacity (ECEC) was determined by summation method, following the extraction of exchangeable acidity with the aid of IN KCL. Coleman (in Kamprath, 1984) suggested that the determination of CEC through the summation of exchangeable bases plus KCL exchangeable acidity serves as a more realistic method of evaluating the actual amount of bases experienced by plants. The percentage organic carbon content was determined with the aid of potassium dichromate method of Walkey and Black (1974), available phosphorus by Bray and Kurtz (1945) method and total nitrogen by Kjeldal method (Jackson, 1962). The results obtained are presented in Table 2.



The experimental design employed was randomized complete block design (RCBD) consisting of five (5) treatments and three (3) replicates. A table of random numbers was employed in assigning treatments to each block. The five treatments used are as follows:

- To : Potato planted on flat bed without tree rows and green manure of A. lebbeck.
- T1 : Potato planted in the alleys of A. lebbeck without green manure.
- T2 : Potato planted with green manure of A. lebbeck at 5 ton ha⁻¹ without its tree rows.
- T3 : Potato planted in alleys of A. lebbeck tree rows with its green manure at 5 tonha⁻¹
- T4 : Potato planted in alleys of A. lebbeck tree rows with its green manure at 10 ton ha⁻¹

Each plot/replicate in a block was 3m x 2m, the green manure was single application two weeks before planting the pre - sprouted potato tubers (bertita variety). A. lebbeck tree seedlings had early been raised prior to planting (seedlings were 6 months old before planting (0.60m and 2.0m within and between rows respectively). All necessary tending operations were carried out. Analysis of variance (ANOVA) was employed in analyzing the data collected on the soil samples, apparent growth parameters (plant height, number of leaves, stem count, collar girth) and yield parameters (tuber count and tuber weight) in order to find out if there were significant differences among treatments and blocks owing to the possible influence of the green manure of A. lebbeck and its tree rows. Duncan's Multiple Range Test (DMRT) was used where significant differences were recorded in separating the mean values of the variables so as to help in giving appropriate recommendations (Table 3).

2.3 Post – Experimental Soil Sample Collection and Analysis

Immediately after final harvest at the 5th planting season, soil samples were collected for laboratory analysis by employing the same method of analysis earlier described (in pre-experimental soil sample analysis). Samples from the five treatments (T0, T1, T2, T3 and T4) were analyzed (three replications per

treatment). A comparison between the results from composite samples of pre and post (final) experiment soil nutrient analysis was made using the analysis of variance technique (ANOVA). Thus, improvement or effect on the nutrient status of the soil due to the nitrogen fixing activities of Albizia lebbeck tree rows and incorporated green manure (of this tree species) was evaluated and all the soil samples were analyzed by the same analyst and with the same sets of chemicals (reagents) at the Soil Science Department of Faculty of Agriculture, Ahmadu Bello University, Zaria and Institute of Agricultural Research, ABU, Zaria, Nigeria.

3. RESULTS AND DISCUSSION

3.1 Soil physical properties

Particle size analysis of the three randomly selected locations at the experimental site (prior to planting which served as three replicates) indicated that the soils in the granite area are predominantly sandy clay loam (Table 1). The 0 –10 cm depth indicated that the soil had a very high percentage of sand (61%). The silt and clay contents were 26% and 13% respectively. This agrees with Olowolafe (2007) who observed that the soil in the study area is an Alfisol which is characterized by increase in clay content with increase in soil depth. For the 10 – 25 cm and 25 – 40 soil depths, the soil texture is sandy clay loam due to the fact that the sand had the highest percentage. It was observed that the sand and silt proportions decreased with increasing depth (from 0 – 10, 10 – 25, 25 – 40 cm depth) while the clay content increased with depth. For instance, the 0

– 10 cm depth had 13% clay which increased to 23 and 33 percent respectively and at 10 – 25 cm and at 25 – 40 cm depths. This supports the classification as Alfisol owing to increase in clay content with depth which is an important property of Alfisol. However, analysis of variance indicated no significant difference in the % clay at the three soil depths (Table 1).. The nine (9) samples from the three soil depths of T4 were predominantly sandy loam (except two samples) probably because T4 received the highest rate of green manure application (10 ton ha⁻¹). This must have increased the ratio of smooth to coarse fragment in favor of smooth. T1, T2 and T3 had three (3) of their replicates (samples) being sandy clay loam as opposed to T4 with only two (2).



Though T0 also had only two of its nine samples being sandy clay loam which could be attributed to the initial textural class of T0 and probably little fertility gradient as no green manure was applied to the treatment (i.e. T0). There was little (non-significant) difference between the pre and post planting soil texture which was probably the reason why analysis of variance on the clay content indicated no significant difference in the soil texture before and after planting. This agrees with Olowolafe (2003) who had earlier observed that soils developed from granites are mainly loamy textured with sandy clay loam, clay loam and sandy loam constituting the dominant textural classes.

3.2 Chemical properties of the soil samples (before and after planting)

The significant difference in block effect with regard to pH at 10 – 25 cm and 25 – 40 cm soil depths ($P < 0.01$ and $P < 0.05$ respectively) was observed and this could be attributed to addition of organic matter in form of green manure from *Albizia lebbek*. Since the pH (H₂O) was initially low (4.5) before planting which made the soil very strongly acid (Troug, 1948; Olowolafe, 2003) but rose to a range of 5.1 to 5.4 in T2-T4 which indicates the influence of the green manure application (Table 2). Kunishi (1982) had earlier observed that organic matter raises the soil pH, helps in ameliorating phyto-toxicity in acid soils, decreases soluble manganese and

exchangeable aluminium (Al) and increases calcium and available phosphorus. Olowolafe (2003) had also reported that the addition of more organic matter could lead to the release of more basic cations that resulted in the improvement of base saturation and soil pH indicated no significant difference at 0-10 cm depth was probably as result of crop/plant absorption or leaching. The soil structure also could have been improved probably owing to the application of the organic manure in T2, T3 and T4 which could have probably improved infiltration and porosity of the soil. Thus, the green manure applied and the tree rows of *A. lebbek* might have contributed in reducing the acidity of the soil, which brought about better yield of potato in T1-T4 over that of T0.

This agrees with Kunishi (1982) who observed that the pH range of 5.5-8.5 is within the pH range of tolerance for crop production and that soil acidity does result to low agricultural productivity. This could be the reason why available P values were higher before planting (23.45 pp at 0-10 cm depth, increased to 24.62 pp in T2 but decreased to a range of 3,7 -18.90pp in T0, T1, T3 and T4) and those treatments with fairly low values could be as a result of lower fixation rate and higher rate of absorption by plants (*A. lebbek* and potato) in the treatments.

Table 1: Particle size distribution (%) and textural classes* (TC) of the pre and post experimental soil samples

Soil Depth (cm)	Replicate 1				Replicate 2				Replicate 3				
	Sand	Silt	Clay	TC	Sand	Silt	Clay	TC	Sand	Silt	Clay	TC	
Before planting													
0-10	61	26	13	SL	47	18	35	SCL	61	22	17	SL	
10-25	59	18	23	SCL	61	14	25	SCL	61	14	25	SCL	
25-40	51	16	33	SCL	53	16	31	SCL	49	16	35	SCL	
After Planting													
T ₀	0-10	75	12	13	SL	65	18	17	SL	67	18	15	SL
	10-25	71	14	15	SL	61	18	21	SCL	63	18	19	SL
	25-40	65	16	19	SL	61	16	23	SL	61	16	23	SCL
T ₁	0-10	75	12	13	SL	67	20	13	SL	63	22	15	SCL
	10-25	71	12	17	SL	65	18	17	SL	49	24	27	SCL
	25-40	69	12	19	SL	61	16	23	SCL	63	22	15	SL
T ₂	0-10	69	16	15	SL	63	16	21	SCL	61	18	21	SCL
	10-25	69	14	17	SL	67	18	15	SL	59	16	25	SCL
	25-40	63	18	19	SL	71	18	11	SL	63	22	15	SL
T ₃	0-10	75	12	13	SL	77	20	03	SL	67	20	13	SL
	10-25	71	12	17	SL	67	20	13	SL	65	16	19	SL
	25-40	59	24	17	SL	61	16	23	SCL	61	16	23	SCL
T ₄	0-10	61	22	17	SL	61	16	23	SCL	61	22	17	SL
	10-25	65	16	19	SL	65	16	19	SL	59	20	21	SL
	25-40	63	14	23	SCL	63	20	17	SL	67	22	11	SL

N.B. TC = Textural Class, SL = Sandy Loam, SCL=Sand Clay Loam (see section 2.2 for what T₀- T₄ denote).



Magnesium (Mg) is one of the exchangeable cations that dominates the exchange site of the soils (Table 1). The significant effect of blocks on Mg content at 0 – 10 cm depth could be attributed to the influence of fertility gradient (in respect of block) at the experimental site. Generally, soils derived from granites are low or very low in exchangeable Ca and Mg (Olowolafe, 2003). Similarly, the significant effect of the treatments on K levels at 0 – 10 cm and 10 – 25 cm could be as a result of the application of green manure which might have influenced the K content in the soil samples from the treatments ((Table 2). The generally low K levels which could be as result of leaching and the low K content of the soil parent material as earlier reported by Olowolafe and Dung (2000). The non-significant effect of the treatments on Na observed at all soil depths could be attributed to the low level of variations among the mean values of the treatment which ranged from 0.15 – 0.26 cmol

(+) kg-1 which is not enough to bring about significant differences (Table 2).

The observed decrease in the effective cation exchange capacity (ECEC) from a range of 6.12 to 6.62 downwards the soil strata (0 – 40 cm depth) before planting to a range of 3.65 to 5.79 (Table 2) down the strata (0 – 40 cm depth) after planting could be due to absorption by plants, crop removal. Also, the values of the ECEC reduced because of the reduction in the values of exchangeable cations and exchangeable acidity since ECEC is the summation (addition) of the exchangeable cations and exchangeable acidity (Table 2). Therefore, the increase in exchangeable acidity and ECEC from the surface soil to the deeper strata of the soil (subsoil) in the study site could be as a result of infiltration of the exchangeable cations or their absorption by the potato crops for growth and yield.

This is in line with the earlier observation made by Olowolafe and Dung (2000) in respect of soils derived from the biotite-granite on the Jos Plateau (Nigeria) with regard to their nutrient status and management for sustainable agriculture. Apart from factors such as infiltration, absorption by crops (crop removal), mini- erosion could also be a contributory factor for the decline in exchangeable acidity and ECEC in the surface soil. This agrees with the reports by Lal (1981) and Olowolafe (2007) who observed that considerable or substantial proportion of topsoil nutrients are lost as a result of erosion.

With regard to the yield, it was obvious from the data collected that T4 had the highest values in growth and yield (tuber count, tuber size, tuber weight) values in all the five cropping seasons owing to the fact that it was the treatment that received the highest level of green manure application (10 ton/ha) with tree rows of *A. lebeck*.. Also, significant differences were observed at 1% probability level (Table 3, Plate 1).

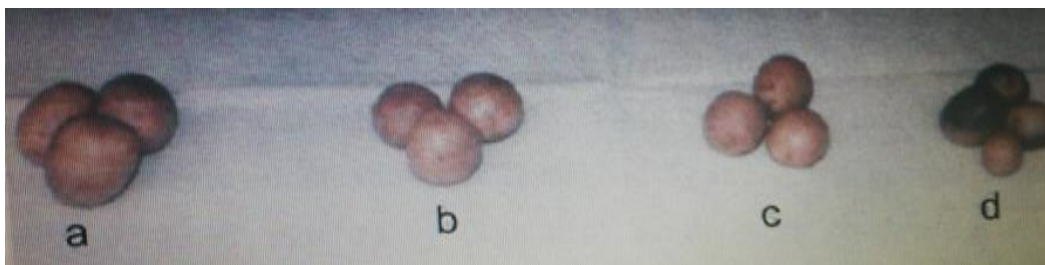


Plate 1: Different sizes of harvested potato tubers (a: > 50mm, b: 40-50mm c: 30-40mm, d: < 30mm in diameter)



Table 2: Some chemical properties of the pre-experimental soil samples as influenced by the treatments after planting at three soil depths

Treatments	pH		OM	TN	Avail. P	Ca	Mg	K	Na	E.A	ECEC
	H ₂ O KCl		(%)	(%)	(ppm)			cmol (+) Kg ⁻¹			
Before Planting											
(0 – 10 cm Depth)	4.5b	4.2ab	1.94a	0.10ab	23.45a	4.07a	0.78b	0.22a	0.18ab	0.87a	6.12a
After Planting (0 – 10 cm)											
T ₀	5.2a	4.5a	1.22b	0.06b	15.52b	2.06c	0.61c	0.17ab	0.15b	0.73a	3.72b
T ₁	4.5b	4.3ab	1.29b	0.06b	16.40b	2.07c	0.63c	0.11ab	0.19ab	0.54a	3.54c
T ₂	5.2a	4.5a	1.38b	0.06b	24.62a	3.00ab	0.72b	0.14ab	0.23a	0.80a	4.89ab
T ₃	5.1a	4.0b	1.45b	0.08b	6.45c	2.67b	0.69c	0.20a	0.19ab	0.73a	4.48ab
T ₄	4.7ab	4.1b	1.69a	0.33a	18.90b	3.07ab	0.93a	0.17ab	0.20a	0.60a	4.97ab
Before Planting											
(10 – 25 cm)	4.3b	3.9	1.15b	0.07a	3.79c	3.93a	0.80b	0.15a	0.20a	1.20a	6.28a
After Planting (10 – 25 cm)											
T ₀	4.9b	4.5a	1.03c	0.05a	10.92b	2.40b	0.46c	0.14a	0.17ab	1.13a	4.30b
T ₁	4.8b	4.2ab	1.24b	0.07a	18.22a	3.07ab	1.16a	0.11a	0.20a	0.73b	5.27ab
T ₂	5.1ab	4.4a	1.26b	0.08a	13.79ab	1.81c	0.34c	0.17a	0.26a	1.07a	3.65b
T ₃	5.4a	4.4a	1.57a	0.08a	7.29c	2.87b	0.81b	0.19a	0.20a	1.47a	5.54ab
T ₄	5.1ab	4.5a	1.38a	0.08a	10.38b	3.27a	0.99b	0.17a	0.18a	1.07a	5.68ab
Before Planting											
(25 – 40 cm)	4.3b	3.7a	0.79c	0.07a	3.04b	3.60a	0.52c	0.18b	0.27a	1.87a	6.44a
After Planting (25 – 40 cm)											
T ₀	5.1a	4.6a	0.95c	0.06a	4.46b	2.87b	1.19a	0.16b	0.18ab	1.40ab	5.80ab
T ₁	5.3a	4.4a	1.05b	0.07a	3.90b	2.73b	0.66b	0.14b	0.21ab	1.13b	4.87b
T ₂	4.8b	4.4a	1.14a	0.31b	4.43b	2.20c	0.76b	0.47a	0.16ab	1.33b	4.92b
T ₃	5.4a	4.4a	1.15a	0.07a	5.02a	2.53b	1.07a	0.16b	0.16ab	1.53a	5.45b
T ₄	4.9b	4.5a	1.03b	0.27b	6.88a	1.93c	0.29c	0.13b	0.15ab	1.13b	3.63ab

OM = Organic Matter, TN = Total Nitrogen, E.A. = Exchangeable Acidity, ECEC Effective Cation Exchange Capacity. Each value represents mean value from three replicates from a treatment. Mean values with the same letters are not significantly different at 5% Probability level by DMRT



Table 3: Germination/Seedling Emergence, Growth and yield parameters of Irish potato in the 1st, 2nd, 3rd, 4th and 5th cropping seasons.

Treatments (5)	Germination		Plant Ht (cm)	Growth Parameters			Yield Parameters	
	%S.E. (7 DAP)	%S.E (14 DAP)		Leaf Count	Stem Count	Collar Girth(cm)	Tuber Count	Tuber Yield (t/ha)
1st Season								
T ₀	70.0a	97.0a	44.7d	24.7d	3.0a	2.2e	112.3c	5.03d
T ₁	52.06b	98.0a	51.3c	27.0d	2.7ab	2.8d	109.0c	5.08d
T ₂	41.0c	97.0a	53.7c	41.3b	2.3ab	3.07c	139.0b	8.36b
T ₃	62.0ab	97.7a	55.7b	35.7c	2.3ab	3.4b	113.0c	7.98c
T ₄	57.3b	99.0a	66.3a	56.7a	2.0b	4.5a	160.7a	9.36a
2nd Season								
T ₀	29.7b	92.7ab	48.0e	30.0c	2.3b	2.3e	79.7d	5.19e
T ₁	24.3c	90.0ab	55.7d	35.0c	2.7a	3.0d	111.0c	5.43d
T ₂	24.0c	87.0b	58.7c	53.0b	3.0a	3.4c	153.7a	9.72b
T ₃	33.7a	87.7b	62.3b	52.0b	2.3b	3.5b	127.7b	8.90c
T ₄	24.7c	95.0a	68.3a	67.3a	3.0a	4.7a	160.7a	10.41a
3rd Season								
T ₀	58.3b	94.7b	62.0c	36.7d	3.0a	2.4e	92.3c	5.30e
T ₁	54.7b	98.3a	65.0bc	52.3c	3.0a	3.3d	94.7c	5.40d
T ₂	43.7c	98.0a	67.7b	61.7b	3.0a	3.6c	151.7a	9.13b
T ₃	71.7a	97.7ab	63.7c	64.0b	2.7a	3.5b	118.0b	8.61c
T ₄	56.7b	97.0ab	75.3a	70.3a	2.7a	4.9a	93.7c	9.80a
4th Season								
T ₀	36.3b	93.0ab	64.7d	44.0e	3.0a	2.5e	95.7bc	5.22d
T ₁	31.0c	92.0b	70.3c	60.0d	3.0a	3.5d	93.7c	5.74c
T ₂	29.0c	95.0ab	76.3b	66.0c	2.0b	4.3b	142.7a	9.61a
T ₃	33.0bc	84.0c	74.3b	72.3b	2.3b	4.1c	103.3b	8.90b
T ₄	41.0a	97.0a	80.7a	77.7a	2.3b	5.3a	87.0d	9.73a
5th Season								
T ₀	61.0a	93.0a	63.7d	46.0c	2.7a	3.1e	97.0c	5.28e
T ₁	55.3a	91.7a	70.7c	72.3b	2.7a	3.5d	91.0c	5.85d
T ₂	59.0a	92.3a	77.3b	71.0b	2.3a	4.4b	160.7a	9.63b
T ₃	59.3a	94.0a	71.3c	70.3b	2.7a	4.2c	142.7b	9.02c
T ₄	63.0a	94.0a	82.3a	78.7a	2.3b	5.3a	161.7a	11.96a

S.E. = Seedlings' Emergence. Mean values with the same letters were not significantly different at 5% level by Duncan's Multiple Range Test (DMRT). See section 2.2 for what T₀-T₄ denote.



4. CONCLUSION

Indubitably, reasonable impact/effect of the *Albizia lebbek* trees on the soil physical and chemical properties at the experimental site within the five cropping seasons (3 yrs) had been observed. This is not unconnected with the green manure application, litter from the *A. lebbek* trees and its N₂ fixation activities. Also, better positive effects are expected in the long run in terms of the soil physical characteristics (structure, texture, bulk density, porosity, water holding capacity, permeability/hydraulic conductivity) and chemical properties (pH, organic matter, total nitrogen, available phosphorus, K, Ca, Mg, S, Zn, Mn, Bo, Mo, Cl, exchangeable acidity, cation exchange capacity). Thus, a reasonable improvement/modification on the soil nutrient status (fertility) in the agroforestry farm will be achieved which will concomitantly lead to increased yield of crops in the alley cropping farm, reduced/lesser cost of production and better microclimatic condition on sustainable basis.

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