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Full Length Research Paper

Effect of Soil Amendments on some Soil Chemical Properties and Growth of Rubber Seedlings *(Hevea brasiliensis)* in Southern Nigeria

*** Idehen, C.N.,[1]Orhue, E.R.[2].,Uwumarongie,A.M.D[1].; Okundia,R.O[1] and Ehiwe, D[1].**
[1]*Rubber Research Institute of Nigeria, Iyanomo. P.M.B 1049, Edo State, Nigeria.*
[2]*Department of Soil Science, Faculty of Agriculture, University of Benin, Nigeria.*

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Corresponding Author:
Idehen, C.N
Rubber Research Institute of Nigeria, Iyanomo. P.M.B 1049, Edo State, Nigeria.

Abstract
Field trials were conducted in the cropping seasons at Rubber Research Institute of Nigeria (RRIN) Iyanomo to determine the response of rubber seedlings to the application of poultry manure and urea fertilizer in the poly bag and ground bed nursery. The study was a factorial experiment arranged in a randomized complete block design (RCBD). The poultry manure treatments were 30 and 60 t/ha while the urea treatments were 30 and 60 kg/ha and a control. The treatments were replicated three times. The ground-bed was 1.5 x 1m with 1m furrow in between the plots while the poly bags were 1.8m x 1m with 1m spacing in between the plots. Rubber seedlings were planted at a spacing of 30cm x 30cm on the ground beds. Soil laboratory analysis was done before and after treatments. Plant growth parameters were taken at 7 months after treatments application. The result showed that the plant height, collar girth, leaf area and number of leaves were significantly increased ($P<0.05$) by the application of poultry manure and Urea fertilizer in the ground bed and poly bag nursery when compared to the control. However, the optimum response in the growth parameters of rubber seedlings observed were recorded at the highest rate of poultry manure (60 t Pm/ha) application in the ground bed nursery while the highest rate of Urea (60 kg Urea/ha) application in the poly bag nursery respectively. The result further showed that at seven months after treatments in the poly bags and ground bed nursery there was a significant increase ($P<0.05$) in general soil properties with poultry manure at 30 and 60 t/ha treatments showing the highest rate in the ground bed nursery while urea 30 and 60 kg/ha treatments also showing the highest rate in the poly bag nursery. Based on the results obtained, the use of poly bag in the nursery and application of urea proved to be more efficient when compared with that of ground bed nursery.

Keywords: *Ground bed nursery, Polybag, Urea, Poultry Manure, Iyanomo*

Introduction

The genus *Hevea* is a member of the family *Euphorbiaceae* comprising of ten (10) species of which Para rubber tree, *Hevea brasiliensis* (Wild.ex A. de juss) Mueller Argoviensis, is the only one planted commercially. Organized production of natural rubber to meet industrial need is more than 55 years old. Natural rubber (NR) is very important in the manufacture of heavy duty and high speed tyres. It is specifically useful in tyre manufacture involving heat build up such as in vehicle, aviation, e.t.c. It is able to do this because of its good tear strength, low heat buildup, good green strength and mixing capacity (Baulkwill 1989). One of the most important bases for increased rubber production lies in the development and effective distribution of improved rubber (seedlings) that are high yielding, disease and wind resistant, early maturing and high field survival rate. This can be achieved through proper soil fertility management in the nursery where these seedlings are produced.

The fertility management of rubber at the juvenile stage is critical to the productivity of rubber at maturity. The soils of the rubber belt of Nigeria with few exceptions have sub – optional nutrient status. They are well known for their low available phosphorus (P), their Nitrogen (N) content is also low as a result of low organic matter content and the available potassium (K) content is invariably low except in some soils of North Calabar (Onuwaje and Uzu, 1980), hence, the need for soil amendment using fertilizer and maintaining good agronomic practices. Fertilizer if used properly enhances the growth and productivity of rubber. While fertilizers are essential to modern agriculture, their overuse can have harmful effect on plant and soil quality. Hence, organic manures can serve as alternative to mineral fertilizers for improving soil structure and also improves biological activities, soil tilt and soil chemical properties (Morgan and Jackson, 1988). This study will take a look at the agronomic benefits of rubber planting material production both in the ground bed and poly bag nurseries. Hence this investigation was initiated to determine; the effect of Poultry manure and Urea on the growth and development of rubber seedlings and also on some soil chemical properties.

Materials and method

Data Collection methods and analysis

This study was conducted at Rubber Research Institute of Nigeria (RRIN) Iyanomo near Benin City Edo State. The study area fall between latitude $6^0 00^1$ and $7^0 00^1$ North and longitude $5^0 00^1$ and $6^0 00^1$ East of Equator. The rainfall pattern is bimodal with peaks in the months of July and September but the highest in July and a short dry spell in August. Some of the physico-chemical properties of the soil before the experiment are showed in Table 1, while that of the poultry manure is showed in Table 2. The study was two trials consisting of; determination of effect of fertilizer on rubber seedling growth in a factorial experiment consisting of two levels each of poultry manure (30 and 60 t/ha) and urea (30 and 60 kg/ha) and a control which was arranged in a randomized complete block design (RCBD) with each treatment replicated three times. The ground-bed was 1.5 x 1m with 1m furrow in between the plots and the poly bags was 1.8m x 1m with 1m spacing in between the plots. Rubber seedlings were planted at a spacing of 30cm x 30cm on the ground-beds (i.e. 90,000 rubber seedlings per hectare).

Growth data (collar girth, plant height, number of leaves and leaf area) of the rubber seedlings was taken at seven (7) month from five (5) randomly selected seedlings per plot. Soil chemical characteristics were generated from samples collected before and at the end of the growing season using standard soil analytical procedures. All data collected were subjected to statistical analysis using Genstat release 8.1 (2008) statistical package. The measurable variables were tested for significance with one way analysis of variance (ANOVA) procedure in a randomized complete block design. The treatment mean comparison was done using least significance difference (LSD) and all par wise comparison was separated using Duncan Multiple Range Test (DMRT) at 5% level of probability.

Results

Physical and Chemical Properties of the Soil before Cropping

The physical and chemical properties of the soils in the two seasons before the trials are shown in Table 1.

Table 1: Physico-chemical properties of the soil before cropping

Soil properties	Characteristics
Part. Size g/kg Sand	842.40
Silt	42.80
Clay	114.80
Texture	LS
pH (1:2)	4.87
Organic Carbon (g/kg)	2.46
Organic Matter (g/kg)	4.24
Excha. Cations (cmol/kg)	1.92
Ca	
Mg	0.16
Al	1.00
H	0.20
K	0.19
Na	0.74
Avail P (mg/kg)	8.36
Total N g/kg	1.60
ECEC (Cmol/kg)	4.35
BS (%)	60.21

LS= *Loamy sand*
BS= *Base Saturation*

Properties of Poultry Manure used in the trials

The chemical properties of the poultry manure used for the experiment are shown in Table 2

Table 2: Properties of poultry manure used in the experiment

Parameters	Value
pH	7.53
Total Carbon (g/kg)	3.31
Total matter (g/kg)	5.69
Total cations %	
Calcium	8.00
Magnesium	11.20

Aluminium	0.60
Hydrogen	1.10
Potassium	5.71
Sodium	20.44
Total P (mg/kg)	34.35
Total N (g/kg)	2.20
ECEC C mol/kg	45.35

Effect of soil amendments on rubber seedlings growth in the Ground bed Nursery

Table 3 shows the effect of urea and poultry manure on seedling growth in the groundbed nursery that there were no significant differences (P<0.05) among the treatments in the leaf area. Significant differences (P<0.05) among the treatments were recorded in plant height, girth and numbers of leaves with the treatment of 60 t Pm/ha having a higher value. It was observed that the response of rubber seedlings growth characteristics in the poultry manure treated plots performed better than the urea treated plots.

Table 3: Effect of poultry manure and urea on the plant height, stem girth, leaf area and numbers of leaves of rubber seedlings in the ground bed nursery

Treatment	Plant Height(cm)	Girth(cm)	Leaf Area(cm)	No of Leaves
Control	79.00c	10.12ab	30.69	8.00b
30 t PM/ha	92.65ab	10.90ab	39.70	12.40a
60 t PM/ha	102.31a	11.64a	36.82	13.33a
30 kg Urea/ha	82.37bc	9.44b	30.03	10.07ab
60 kg Urea/ha	92.75ab	10.62ab	39.22	10.00ab
LSD(0.05)	**12.78**	**2.154**	**NS**	**3.087**

NS = Not significant and means with the same letters in the column are not significantly different from one another at 5% level of probability

Effect of soil amendments on rubber seedlings growth in the Poly bag Nursery

Table 4 shows that there were no significant difference (P<0.05) among the treatments in the leaf area. In plant height, girth and numbers of leaves there were significant difference (P<0.05) among the treatments with 60 kg Urea/ha showing a higher value. However, it was observed that rubber seedlings height, stem girth, leaf area and numbers of leaves responded better with the treatment of urea than the poultry manure treatments.

Table 4: Effect of poultry manure and urea on the growth characteristics of rubber seedlings in the poly bag nursery

Treatment	Plant Height(cm)	Girth(cm)	Leaf Area(cm)	No of Leaves
Control	78.33b	9.01b	29.7	11.73ab
30 t PM/ha	94.90ab	10.91ab	29.43	8.73b
60 t PM/ha	87.47ab	11.42a	34.01	11.47ab
30 kg Urea/ha	91.93ab	10.61ab	35.41	13.60a
60 kg Urea/ha	100.86a	11.92a	35.65	12.53ab
LSD(0.05)	**15.49**	**1.998**	**NS**	**3.709**

NS = Not significant and means with the same letters in the column are not significantly different from one another at 5% level of probability

Effect of Soil Amendments on some Soil chemical properties in both the Poly bag and Ground bed Nurseries

Table 5 and 6 shows the effects of the organic(poultry manure) and inorganic(urea) fertilizer used on some soils chemical properties in the poly bags and ground bed nursery, this showed a significant differences (P<0.05) in some of the chemical parameter and a general increase due to the effect of these soils amendments.

Discussion

In the poly bag nursery, the higher rate of growth of the seedlings treated with urea fertilizer compared with those treated with poultry manure, could be attributed to the higher rates of nitrogen that were more easily released into the soil solution and trapped within the poly bags making them more easily available to the plant as compared with the nutrients in the organic fertilizer (poultry manure) that are not easily released for plant use. The minimal loss of nitrogen through volatilization and leaching in the poly bags was also reported by Yogaratnam (1980). He noted that there is a reduction of nitrogen loss by volatilization and leaching when urea is applied to young plant in the poly bag nursery as against applying urea fertilizer in the ground bed.

Table 5: Effect of urea and poultry manure on some soil chemical properties in the poly bag nursery

TREATMENT	pH	Org C	Org M	Total N	Avail. P	K	Mg	Ca	Na	EA	ECEC	%BS
	1:2	←	g/kg	→	mg/kg	←			Cmol/kg		→	
Control	5.20	1.59b	2.73	0.60b	7.42b	0.15c	0.11b	1.60c	0.44	1.10b	4.26b	73.71ab
30 kg Urea/ha	5.04	2.04ab	3.50	1.70a	6.87b	0.24b	1.92c	2.10b	0.33	0.70c	4.36b	74.50ab
60 kg Urea/ha	4.99	2.01ab	3.45	1.90a	7.38b	0.32a	0.44b	2.76a	0.76	0.90c	6.07a	76.65a
30 t PM/ha	4.88	2.23ab	3.83	1.20a	7.52b	0.18c	1.32a	2.24b	0.81	1.61a	4.31b	70.40c
60 t PM/ha	4.96	2.53a	4.35	1.40a	11.11a	0.19bc	1.96c	2.10b	0.63	0.60c	4.65b	72.03b
LSD(0.05)	**NS**	**0.70**	**NS**	**0.70**	**0.80**	**0.70**	**0.50**	**0.40**	**NS**	**0.25**	**0.80**	**0.40**

NS= not significant and means with the same letters in the column are not significantly different From one another at 5% level of probability

Table 6: Effect of urea and poultry manure on some soil chemical properties in the ground bed nursery

Treatment	pH	Org C	Org M	Total N	Avail. P	K	Mg	Ca	Na	EA	ECEC	%BS
	1:2	←	g/kg	→	mg/kg	←			cmol/kg		→	
Control	4.80a	1.50c	2.58	0.50b	6.72ab	0.20	0.08c	0.30c	0.70	1.30bc	3.58d	62.45a
30 kg Urea/ha	4.68b	1.85c	3.18	0.90ab	6.21ab	0.22	0.56b	1.50b	0.74	0.80c	4.92b	58.55b
60 kg Urea/ha	4.77a	2.11b	3.62	1.20ab	5.76b	0.20	0.96b	0.96b	0.66	1.10bc	4.88bc	60.50a
30 t PM/ha	4.74a	2.78a	4.78	1.50ab	6.70ab	0.20	1.48a	2.44a	0.63	1.90b	4.44c	54.55b
60 t PM/ha	4.44c	2.83a	4.86	1.70a	7.23a	0.16	1.48a	2.36a	0.52	2.20a	5.65a	49.49c
LSD(0.05)	*0.11*	*0.40*	*NS*	*0.56*	*0.50*	*NS*	*0.90*	*0.50*	*NS*	*0.73*	*0.74*	*0.61*

NS= not significant and means with the same letters in the column are not significantly different From one another at 5% level of probability

This reduced nitrogen loses accounted for the higher physiological growth rates as concluded by Corley and Mok (1972). In the ground bed nursery, the mean plant height, plant girth, leaf area and numbers of leaves for rubber seedlings shows that poultry manure treated plots responded better than the urea treated plots in all the growth characteristics, which can be attributed to the loss of nitrogen either through volatilization and leaching in the urea treated plots as reported by Thorup (1984). He stated that volatilization loss from urea can occur in both acid and basic soils within 24 hours after surface application that the extent of loss can account for 50 %. Keller *et al* (1986) also stated that urea volatilization is almost three times higher in a sandy loam soil with a CEC of 7 meq/kg than in a silt loam with a higher CEC. While the organic fertilizer (poultry manure) performed better because of the slow mineralization and leaching of organic manure from the soil, thereby making nutrients readily available for crop uptake as reported by Brady and Weil (1999). They noted that organic colloids hold nutrient cations (K, Ca and Mg) in easily exchangeable form, wherein they can be used by plants but are not too easily leached out of the profile by percolating water, through its higher ionic exchange capacity, organic matter also provides much of the pH buffering capacity in soils, in addition, nitrogen, phosphorous and micro nutrients are stored as constituents of soil organic matter from which they are slowly released through mineralization, thereby making it available for plant optimum use. The higher growth rate in fertilized soil is attributable to higher nutrient supplies by the fertilizer. Corley and Mok (1972) also reported higher rate of leaf production and total number of leaves per plants with increase in nitrogen application. The result of the soil chemical properties before and after application of the treatments showed improvement in the general soil chemical properties after application when compared with the value before application of treatments, which could be ascribed to the application of urea and poultry manures treatments on the ground bed nursery as reported by Brady and Weils (1999). They opined that, addition of fertilizers increases the nutrient pool of the soil.

Conclusion

The result showed that rubber seedlings height, girth, leaf area and number of leaves were significantly increased by the application of Urea and Poultry manure. There were improvements in soil properties in both poly bags and ground bed nursery. The application of Urea reduced loss of soil nutrients through leaching and volatilization of nitrogen with the use of polythene bags. 60 kg Urea/ha fertilizer application in the poly bag was more efficient in the raising of rubber seedlings than poultry manure in the poly bag and ground bed nursery.

References

Baulkwill, W.J. (1989). The history of natural rubber production. In C.C.Webster and W.J. Baulkwill (ed) Rubber, Longman Scientific and Technical Singapore.p.1-54

Brady N.C. and Weil, R.R. (1999). The nature and properties of soils 12th ed. 1999,1996 by Prentice Hall.Inc. Simon and Schuster. A viacom company upper saddle river. New Jersey. Pp: 326 – 327

Corley, R. H. F. and Mok, C.K. (1972). Effect of nitrogen, phosphorus and magnesium on of oil palm. *Experimental Agriculture*. 8: 347 – 353

Keller, G.D. and Mengel, D.B. (1986). Ammonia volatilization from nitrogen fertilizers surface Applied to no-till corn. *Soil Science. Society. America. Journal*:50: 1060-1063

Morgan, M.A. and Jackson. W.A. (1998). Suppression of ammonium uptake by nitrogen supply and its relief during nitrogen limitation. Phisio. PLANT. 73: 38-45

Onuwaje, O.U and Uzu, F.O (1980). Growth response of rubber seeding to N. P. K. fertilizer .paper presented at the 3rd natural rubber symposium Manaus Am Brazil June 23 – 29, 1980.*Fertilizer Res.J.3:167-175*

Thorup R.M.(1984). Ortho-Agronomy Handbook. A practical guide to soil fertility and Fertilizer use. San Francisco.CA;chevron chemical company. P.454-467

Yogaratnam, N. (1980). Review of the Soils & Plant Nutrition Department for the year 1980. *Rubb. Res. Inst. Sri Lanka.* 69-82