Journal of Research in Forestry, Wildlife & Environment Vol. 11(3) September, 2019
http://www.ajol.info/index.php/jrfwe
jfewr ©2019 - jfewr Publications
E-mail:jfewr@yahoo.com
ISBN: 2141 – 1778
Adeniji et al., 2019

DRY MATTER ACCUMULATION AND GROWTH ANALYSIS OF *Jatropha curcas* L. AS INFLUENCED BY APPLICATION OF POULTRY MANURE AND COW DUNG IN NIGERIA

***Adeniji, I.T., Jegede, O.C. and Kazeem-Ibrahim, F.**

Forestry Research Institute of Nigeria, Jericho Ibadan
***Corresponding author:** *okedunni@yahoo.com*; +23408067386045

ABSTRACT

Growth and yield of Jatropha curcas are low due to poor soil fertility and agronomic practices. An experiment was conducted at the Crop Garden of the Department of Crop Protection and Environmental Biology (CPEB) University of Ibadan on dry matter accumulation and growth analysis of Jatropha curcas as influenced by application of manure. Poultry Manure at 10, 20 and 40 t/ha and Cow Dung at 10, 20 and 40 t/ha (P5, P10, P20, P40 and C5, C10, C20, C40) with control (0 t/ha, M0) were evaluated (5 kg soil; 1 plant/pot)in a Completely Randomised Design. Dry weight and leaf area were obtained at monthly intervals to calculate: Relative Growth Rate, Net Assimilation Rate, Leaf Area Ratio and Leaf Area Duration using the formulae of Roderick (1978).The result showed that treatments P40, C40, P20 and C20 had the highest leaf dry weight (47.67g, 48.71g, 48.91g and 48.11g), while control had the least(23.30g), P40 had the highest stem dry weight (89.13g) which was not significantly higher than stem dry weight of C40 (86.56g), P20 (85.95g) and C20 (80.85 g) and control had the least stem dry weight of 51.78g.Treatment C40had the highest root weight (40.50g) and control had the least value of 25.41g.The net assimilation rate (NAR), relative growth rate (RGR), leaf area ration (LAR) and leaf area duration (LAD) showed that the RGR were higher between 6 and 8 weeks across all the levels. The NAR increased as the level of manure increased. Leaf area duration increased as the plant grew older across all levels while P5, C5 and control had the least. Leaf area ratio was 20.14(cm^2/g) on control and 33.49(cm^2/g) and 39.54 (cm^2/g) on P40 and C40 respectively at last observation. Application of manure up to 20t/ha increased the dry matter accumulation and growth of Jatropha curcas.

Keywords: *Jatropha curcas*, Organic manure, Biodiesel, Environmental sustainability.

INTRODUCTION

Jatropha curcas is a deciduous large shrub that can be 3-5 m tall (Tewari, 1994; El-quesni *et al., 2013*). It is known as physic nut. Species found in Nigeria is wild (Yammama, 2009) and it is called *'Botunje'* or *'Lapalapa Funfun'* in Yoruba language, '*Binidazugu'* in Hausa and *'Mpianya'* in Igbo language. *Jatropha curcas* adapts easily to various climatic and soil types, it can endure drought, salinity of soil and, thus, can be used to green up barren wastelands and also it is suitable for preventing soilerosion (Jones and Miller, 1992).Also out of all plants species that yield oil that can be used as biodiesel, *Jatropha curcas* has been recognized as being the preferred oil seed producing plant, due to high oil recovery and quality of oil (FAO, 2008). *Jatropha* oil is an important product from the plant. Biodiesel is a major substitute for mitigating greenhouse gas emissions (Lopez *et al*., 1997). In addition *Jatropha* seed oil can be used in treating some human and veterinary diseases; it also exhibits some pesticides properties (Nwosu and Okafor, 1995; Oyi *et al.*, 2007).

Growth is a vital function of any plant and is an indication of a gradual increase in number and size of cells. Growth analysis is commonly used to determine success of species in various habitats, competition among species, genetic differences in yield and effects of treatment on crops (Olaniyan, 2013). Growth analysis is the most simple and precise method to evaluate the contribution of different physiological indices of plants. Total dry matter is the spatial and temporal integration of all plant processes; rate of dry matter accumulation is the product of total incident solar radiation, the absorption of incident solar radiation by the crop canopy and the efficiency of conversion of absorbed solar radiation into plant dry matter.

Fertiliser is a major source of plant nutrients in crop production and most crops respond to fertiliser application based on need (Adediran *et al.*, 2003). A plant could benefit and manifest to its full potential if it was supplied with appropriate types and amounts of nutrients Akanbi and Togun (2002).Animal wastes have been utilised effectively as fertiliser for centuries and poultry manure and cow dung have long be recognized as perhaps the most desirable of these natural fertilisers because of their high nitrogen content (Sloan*et al.*, 2009 Adeoye *et al.*, 2004).

Plant growth and yield are to a large extent influenced by application of fertilisers (Hussein *et al.*, 2012).This research work is aimed at examining the effects of organic fertiliser application on growth and yield of *Jatropha curcas.*

MATERIALS AND METHODS

Study Area

The studies were carried out at the Crop Garden of the Department of Crop Protection and Environmental Biology (CPEB) University of Ibadan. Ibadan is located between longitude7^0 234" N to 7^0 396" N and latitude 3^0 550" E to 3^0 916" E. Elevation: 231m above sea level (Wikipedia). The experiment was 2 x 5 (2 manure types at 5 levels) factorial using poultry manure (P) and cow dung (C) at five different levels. The treatments were in a Completely Randomized Design (CRD) replicated four times. The factorial combination of the treatment gave a total of 10 pots per replicate; each pot was duplicated four times to give room for monthly assessment of dry weight and leaf area. Pots of 5 liters size were filled with 5kg soil and equivalent weight of 5, 10, 20 and 40 t/ha of cured poultry manure (P5, P10, P20, P40) and cow dung (C5, C10, C20, C40) were added into each designated pot while 0t/ha served as control (M0). The manure was allowed to incubate in the soil for two weeks to give room for its stabilization. Seeds of *Jatropha curcas* were sown at two seeds per hole at a depth of 3cm. Watering was carried out to maintain the soil at field capacity. After two weeks thinning was done as required to have 1 seedling per pot. Manual weeding was carried out at 14 days interval and white flies were controlled with Cypermethrin at the rate of 2L/ha according to manufacturer recommendation, to prevent damage to the plant when infestation was noticed. At 8 WAS (weeks after sowing). Leaf Area (cm^2) was measured using Tayo and Togun (1984) method. Plant dry matter was obtained by partitioning plants into leaves, stem and root and put in the oven set at 80°C to dry to constant weight so as to calculate plant growth. This was done at monthly interval until 28weeks after sowing(WAS) when flower buds were noticed. The dry weights were used to calculate the following growth parameters: Relative Growth Rate (RGR), Net Assimilation Rate (NAR), Leaf Area Ration (LAR) and Leaf Area Duration (LAD) using the following formulae (Roderick, 1978).

$$RGR = \frac{Log\ eW_2 - LogeW_1}{T_2 - T_1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

$$NAR = \frac{W_2 - W_1}{T_2 - T_1}\ X\ \frac{eLogeLA_2 - LogeLA_1}{LA_2 - LA_1} \quad \ldots\ldots 2$$

$$LAR = \frac{\frac{LA1}{W_1} + \frac{LA2}{W_2}}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

$$LAD = \frac{LA_2 - LA_1(T_2 - T_1)}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where:

W_1 = Weight at T_1;

W_2 = Weight at T_2;

T_1 = Time at 1st Sampling Period;

T_2 = Time at 2nd Sampling Period;

LA_1 =Leaf area at T_1;

LA_2 =Leaf area at T_2

Data Analysis

Data collected were analysed using analysis of variance (ANOVA) and significant means were

separated using Duncan Multiple Range Test (DMRT) at p0.05.

RESULTS

The physical and chemical properties of the manure and soil used for the experiment are shown in Tables 1 and 2. The laboratory analysis of the poultry manure and cow dung used in the experiment showed that cow dung had higher carbon (7.41%) than poultry manure (5.97%). The percentage nitrogen in poultry manure (1.66) was higher than that of cow dung (1.06).The soil used for the experiment was loamy sand by texture; the soil in the experimental pot was moderately alkaline (pH 7.10). The Cation Exchange Capacity (CEC) seemed to be adequate (21.40%) due to the high level of Calcium in the soils. Organic Carbon, total Nitrogen and available Phosphorus content were 3.78%, 0.51% and 25.35%.

Table1: Properties of manure used in the experiment on *Jatrophacurcas*

Properties	Manure	
	Poultry Manure (%)	Cow dung (%)
C	5.97	7.41
N	1.66	1.06
P(Avail)	2.43	0.48
K	1.98	1.97
Na	0.68	0.60
Ca	3.95	0.13
Mg	3.73	0.38

Table 2: Physical and chemical properties of pre-cropping soil used in the experiment on *Jatropha curcas*

	Properties	Pot experiment
Textural class	Sand (%)	89.80
	Clay (%)	5.40
	Silt (%)	4.80
	C (%)	3.78
	N (%)	0.51
	P(Avail, %)	25.35
	Base salt (%)	99.75
	C E C (%)	21.40
	K (%)	0.36
	Na($Cmol^1$)	0.94
	Ca ($Cmol^1$)	14.50
	Mg ($Cmol^1$)	5.54
	pH	7.10

The dry matter accumulation of *Jatropha curcas* in response to manure application is shown on Table 3.Treatments P40, C40, P20 and C20 had the highest leaf dry weight (47.67g, 48.71g, 48.91g and 48.11g).The control had the least leaf dry weight (23.30g) which was significantly lower than other treatments. Stem dry weight followed a similar trend as the leaf dry weight, P40 had the highest

weight (89.13g) which was not significantly higher than C40 (86.56g), P20 (85.95g) and C20 (80.85g).Control had the least stem dry weight of 51.78g although not significantly higher than P5 and C5 (60.61g and 61.50g). In terms of root dry weight, C40had the highest root weight, (40.50g), which was not significantly different from P40 (37.61g), P20 (35.96g) and C20 (32.82g).Control still had the least value of root dry weight but not significantly lower than P5 (27.25g), P10 (29.01g), C5 (28.66g) and C10 (30.46g) at$p_{0.05}$.

Table 3: Effect of manure on *Jatropha curcas* dry weight (g)

Treatment, t/ha	Leaf dry weight(g)	Stem dry weight(g)	Root dry weight(g)
M0	323.30d	51.78c	25.41d
P5	32.10c	60.61bc	27.25cd
P10	33.48c	67.42b	29.01bcd
P20	48.91a	85.95a	35.96abc
P40	47.68ab	89.13a	37.61ab
C5	32.39c	61.50bc	28.66bcd
C10	35.46c	68.36b	30.46bcd
C20	48.11a	80.85a	32.82abc
C40	48.71a	86.56a	40.50a

Mean having different letters among treatments are different significantly at $P_{0.05}$ with DMRT
Where; Mo = Control experiment, t/ha; P = Poultry manure, t/ha; C = Cow dung manure, t/h

The effects of organic fertilizer types and rate on plant growth analysis are indicated in Table 4. The net assimilation rate (NAR), relative growth rate (RGR), leaf area ration (LAR) and leaf area duration (LAD) showed that the RGR were higher between 6 and 8 weeks across all the fertilizer level. It started decreasing as the plant grew older. The control, P5 and C5 had the least RGR. The NAR started increasing as the plant grew older from 8 to 28 weeks. It also increased with increase in the level of manure application. Poultry manure also enhanced NAR. Leaf area ratio decreased with age of the plant; it followed a similar trend as NAR by increasing as the level of fertilizer applied increased. Leaf area duration increased as the plant grew older across all the fertilizer levels while P5, C5 and control had the least.

Table 4: Plant growth analysis of *Jatropha curcas* on application of poultry manure and cow dung at different levels

Duration	TRT	RGR(g/g/wk)	NAR(g/cm^2/wk)	LAR(cm^2/g)	LAD(cm/wk)
8-12wks	M0	0.159	0.0001	32.00	1134.11
	P5	0.178	0.0001	28.55	1592.33
	P10	0.201	0.0011	61.11	2893.00
	P20	0.098	0.0013	80.54	4374.56
	P40	0.204	0.0011	86.33	4111.81
	C5	0.181	0.0001	46.88	1721.34
	C10	0.120	0.0010	52.11	2799.86
	C20	0.111	0.0012	59.82	4003.82
	C40	0.193	0.0010	74.03	4231.86
12-16wk					
	M0	0.064	0.0001	32.39	1376.24
	P5	-0.058	-0.0001	28.49	1715.50
	P10	0.088	0.0016	53.11	2969.10
	P20	0.086	0.0019	71.31	4586.82
	P40	0.081	0.0013	78.20	4248.86
	C5	0.079	0.0002	45.92	2051.72
	C10	0.080	0.0018	48.94	2986.44
	C20	0.088	0.0016	56.50	4108.44
	C40	0.090	0.0013	68.29	4471.34
16-20wk					
	M0	0.053	0.0004	28.73	1529.82
	P5	0.047	0.0001	36.66	2277.90
	P10	-0.003	0.0011	45.14	3177.02
	P20	0.019	0.0034	55.08	4854.50
	P40	0.088	0.0025	61.72	4488.64
	C5	0.008	0.0001	34.52	2013.90
	C10	0.062	0.0008	38.33	3069.26
	C20	0.071	0.0016	44.77	4352.46
	C40	0.078	0.0024	54.55	4713.38
20-28wk					
	M0	0.041	-0.0002	20.14	3157.24
	P5	0.077	0.0013	28.51	4735.68
	P10	0.070	0.0019	35.33	6269.72
	P20	0.095	0.0026	40.15	8000.70
	P40	0.078	0.0024	33.49	8143.68
	C5	0.081	0.0013	24.59	3776.96
	C10	0.121	0.0015	29.58	6172.00
	C20	0.084	0.0031	28.19	6850.20
	C40	0.095	0.0026	39.54	8023.24

Where: Mo = Control experiment; P = Poultry manure, t/ha; C = Cow dung manure, t/ha

DISCUSSION

The dry matter accumulation potential of *Jatropha curcas* plants used in this experiment were highly enhance by application of manure as both poultry manure and cow dung at the rates of 20t/ha and 40t/ha increased dry matter accumulation potential of *Jatropha curcas.*Togun*et al.* (2003) and Akanbi*et al.* (2007) reported that organic amendments enhance plant photosynthetic activities and hence more dry matter is produced. Manhas and Gill (2010) found that increment in application of organic manure increased the growth, dry matter accumulation, yield and quality of plant.

Organic fertiliser resulted in significant increase in soil carbon, nitrogen, pH, cation exchange capacity and exchangeable Ca, Mg and K which invariably enhance crop yield and productivity. Adeleye *et al.* (2010) also confirmed that organic manure improved soil organic matter, total N, available P, exchangeable Mg, Ca, K and lowered exchangeable acidity The increase observed in leaf area duration (LAD) as the plants grew older showed persistent of the leaves on older plant and accounted for the overall yield. High relative growth rate (RGR), leaf area duration (LAD) and net assimilation rate (NAR) can be said to be responsible for higher means observed on total dry weight at higher application of manure because of higher photosynthetic capacity which is responsible for yield of plants fertilized at these level.

CONCLUSION

Jatropha curcas responded positively to added fertilizer and fertilised plants were found to grow better than control plants. Organic fertilizer resulted in significant increase in soil carbon, nitrogen, pH, cation exchange capacity and exchangeable Ca, Mg and K which invariably enhance crop yield and productivity. Application of manure up to 20t/ha increases the dry matter accumulation of the treated plants. Manure application improved the photosynthetic capacity of the plant by increase, leaf area duration (LAD) and net assimilation rate (NAR).High relative growth rate (RGR), leaf area duration (LAD) and net assimilation rate (NAR) can be said to be responsible for higher means observed on total dry weight at higher application of manure because of higher photosynthetic capacity which is responsible for yield of plants fertilised at these level. .

Recommendations

The following recommendation(s) are hereby advocated:

i. Application of manure should be encouraged as it enhanced yield and biomass weight.
ii. Application of up to 20t/ha of poultry manure and cow dung could be adopted in *Jatropha curcas* production as it increased the yield of the plant.

REFERENCES

Adediran, J. A., De Baets, M., Mnkeni, P. N. S., Kiekens, L., Muyiwa, N. Y. O and Thys, A. (2003).Organic waste materials for soil fertility improvement in the border region of the eastern cape, South Africa.*Biological Horticulture* 20:283 -300.

Adeleye, E.O., Ayeni, L. S. and Ojeniyi, S. O.(2010). Effect of poultry manure on soil physico-chemical properties, leaf nutrient contents and yield of yam (*Dioscorea rotundata*) on alfisol in southwestern Nigeria. *Journal of American Science* 6:871-878.

Adeoye, G. O., Ojobor S. A. and Adeoluwa, O. O. (2004). Evaluation of potential of co-compost of rice-wastes, cow dung and poultry manure for production of rice. *In: Proceedings of the 29th Annual Conference of the Soil Science Society of Nigeria.* 213–218

Akanbi, W. B. and Togun, A. O. (2002).The influence of maize – stoves compost and nitrogen fertiliser on growth, yield and nutrient uptake of amaranth.*ScientiaHorticulturae*. 93: 1 – 8.

Akanbi, W. B., Adeboye, C .O.,Togun, A. O., Ogunrinde, J. O and Adeyẹye, S. (2007). Growth, herbage, seed yield and quality of *Telfairia occidentalis* as influenced by cassava peel compost and mineral fertilizer. *World Journal of Agricultural Sciences* (4): 508 – 516.

El-quesni, F. E. M, Hasish, K. L, Magda, M. Kandil, M. and Azza, A. M. (2013).Impact of some bio fertiliser and compost on growth and chemical composition of *Jatropha curcas* L. *World Applied Science Journal.* 21 (6) 927-932

FAO, (2008). The state of food and agriculture: Bio fuel; prospect, risk and opportunities 55-59

Jones, N. and J. H. Miller, (1992).*Jatropha curcas*: a multipurpose species for problematic sites. *Land Resources Series* No.1. Asia Technical Department, World Bank, Washington. 42 p

Hussein, M. M., Thaloot, A. T., Tawfik, M. M., Goborah, E. and Mohamed, H. (2012).Impact of mineral and organic fertiliser on vegetative growth of *Jatropha curcas*L. in sandy soil. *Elixir Appl. Botany* 49 .2012. 9714-9717

Lopez ,O.,Foidl, G. and Foidl, N. (1997). Production of biogas from *J. curcas*fruit shells. In: Biofuels and industrial products from *Jatropha curcas - Proceedings of the Symposium "Jatropha*97*", Managua, Nicaragua, Austria* pp. 118-122.

Manhas, S. S. and Gills, B. S. (2010). Effects of planting materials, mulch level and farmyard manure on growth, yield and quality of Tumeric. *The Journal of Agricultural Science* 80(6)227-233

Nwosu, M. O and Okafor, J.I, (1995).Preliminary studies of the anti-fungal activities of some medicinal plants against Basidiobolus and some other pathogenic fungi, *Mycoses*. 38, 191-195.

Olaniyan, (2013).Maize: panacea for hunger in Nigeria, *Afican Journal of Plant Science.9(3) 155-174*.

Oyi, A. R. Onaolapo, J. A. Haruna, A. K. and Morah, C. O. (2007). Antimicrobial screening and stability studies of the crude extract of J*atropha Curcas*L.latex (Euphorbiaceae) *Nigerian Journal of Pharmaceutical Sciences*, 6(2).

Roderick, H. (1978). Plant growth analysis.Arnold,E. ed, Southhampton Camelot press. pp 26-28

Sloan, D. R., Kidder, G and Jacobs, R. D. (2009). Poultry Manure as Fertiliser. Cooperative Extension Services, Department of Dairy and Poultry Science Institute of Food and Agricultural Sciences University of Florida, Gainsville. Article No 1

Tayo, T. O. and Togun, A. O. (1984). Response of Pigeon Pea (*Cajanuscajan*) to the Application of Fertiliser. *Annuals of Applied Biology* 105:293-302

Tewari, D. N, (1994). Brochure on *Jatropha* ICFRI Publication, Dehradun, India. Vol.2

Togun, A. O., Akanbi, W. B. and Dris, R.(2003). Influence of compost and nitrogen fertiliser on growth, nutrient uptake and fruit yield of tomato (Lycopercicumesculentum) *Crop Research* 26 (1):98-105

Wikipedia,http://www.oyostate.gov.ng

Yammama, K. A. (2009). *Jatropha* cultivation in Nigeria; Field experience and cultivation *jatrophaproject@yahoo.com*.26pp