Continental J. Agronomy 5 (1): 18 - 24, 2011 ISSN: 2141 - 4114
© Wilolud Journals, 2011 http://www.wiloludjournal.com
Printed in Nigeria

EFFECT OF DIFFERENT TREE CANOPIES ON THE EARLYGROWTH OF *Jatropha curcas* (LINN) SEEDLINGS

Adeoye O.K[1], Adeyemo A[2], Awoleye M O[1],Owoloja A[1] Olunloyo A[1], Ajibade Y.A[1], Ayeni O.D[1]
[1]Federal College of Forestry Ibadan, [2]Forestry Research Institute of Nigeria, Ibadan.

ABSTRACT
The study was carried out to investigate the effect of tree canopy on the growth of *Jatropha curcas* seedlings. Total of fifteen seedlings each were placed under each of the tree canopy used, making 45 treatments altogether. There were tree treatments namely: (T1) seedlings placed under Gmelina plantation stand, (T2) seedlings placed under *Bambussa vulgaris* stand and (T3) seedlings placed in an open space. The growth parameters of *Jatropha curcas* seedlings observed were stem height, stem diameter, and leaf count. The experiment covers twelve (12) weeks with 8 weeks of thorough observation, measurement and recording of data. Descriptive statistics and analysis of variance were used to analyze the data obtained at 5% level of significance. Duncan Multiple Range Test was used to separate the means. The result of the analysis of variance (ANOVA) showed that there was no significant difference among the treatments with respect to the parameter assessed at 5% level of probability. Further analysis using Duncan multiple range test reveal a significance difference among the treatment with respect to the stem diameter at 5% level of probability. Also, seedlings placed under *Bambussa vulgaris* canopy gave the best performance in term of leaf count and stem diameter while T3-seedling placed in the open space gave the best performance in term of stem height. Finally, the study recommends that for proper raising of *Jatropha curcas* seedlings, seedlings should be raised under *Bambussa vulgaris* canopy as this will provide a modulating effect on the micro climatic condition under which the growth condition of jatropha curcas seedlings can be modified and improved naturally.

KEYWORDS: Tree canopy, Climatic condition, modulating climatic effect,

INTRODUCTION

The effect of tree canopies on the earth cannot be over emphasized because tree canopy is one of the primary factors controlling soil genesis (Zinke, 1962). Tree canopy reduces both the interception of precipitation and the transpiration and thereby increase the humidity of the soil which has a favourable effect on tree growth. According to IUFRO (1997) occasional paper report, tree canopies have modulating effect on the micro-climatic condition under the forest which directly or indirectly affects the growth of plants. Besides, the impact of forest on the climate are particularly marked at the level of plot and those influences are now so well known that they can be used by foresters to improve the growth condition of seeds and trees and to modify the natural development of tree seedlings. Forest cover/canopy has a strong impact on the distribution and plants beneath the forest area (Boctener and Kahod, 1990). In addition, different tree canopy has different modulating climatic effect on plants beneath each canopy and as a result there is an urgent need to study the effect of tree between canopies on the growth of *Jatropha curcas* seedlings.

Jatropha Curcas is a small tree or shrubs with smooth gray bark which extudes a whitish colored watery latex when cut. It is commonly referred to as physic nut or American purging out. In the phillipines, *it* is known as "Tubang bakod" in Taglog; in dlongo, it is called "tawa-tawa" in Asayan, it is known as "kasla" or Tuba-tuba and in maglin danaon, it is known as "kabalitiayay" in Mexico, it is called "pinon" or "pinoncillo" and in Nigeria, it is variously called Bini da Zuga or dinida Zuga "in Hausa," odo- ala" in Ibo, " Lapalapa or Botuje" in Yoruba and "Ujara" in Edo. It *belongs* to the family of Euphorbiaceae which normally grows in the most of the tropics. It can grow almost anywhere and it is a drought resistant perennial soil. It is easy to establish, grows relatively quickly and lives for 40-50years. Its productive life is from 30- 40 years. 2, 200 trees can be planted per hectare and it has important sources of vitamins and nutrients to livestock but is underutilized and estimated (Francais et al 2000).The hardy *Jatropha curcas* is resistant to drought and pests and produces seeds containing 40 %. When the seeds are crushed and processed, the resulting oil can be used in a standard diesel engine, while the residue can also be processed into biomass to power electricity plants and it is the one of the best candidates for future bio-diesel production (Heller, 1996).

Normally, it grows between three and five meters in height but can attain a height of up to eight or ten meters under favorable conditions. It has large green to pale green leaves, alternate to sub opposite, three to five lobed with a spiral phyllotaxix. The petiole length ranges between 6 – 2.3mm and the inflorescence is formed in the leaf axid. Flowers are formed terminally individually with female flowers usually slightely larger and occurs in the hot seasons. In conditions where continuous growth occurs on balance of pistillate or staminate, flower production results in higher number of female flowers. Each inflorescence yields a bunch of approximately 10 or more ovoid fruits. A three, bivalved Cocci is formed after the seeds mature and the fleshy exocarps dries. The seeds become mature when the capsule changes from green to yellow after two to four months from fertilization.

Climatically*, Jatropha curcas* grows almost anywhere even on gravel, sandy and saline soils. Although a native of tropical America it now thrives throughout Africa and Asia. It can thrive on the poorest stony soil, and can grow even in the crevices of rocks. It grows in a number of climate zones in tropical and sub tropical regions of the world and can be grown in areas of low rainfall and problematical sites. In addition, it does well even in the lower temperature and can withheld a light frost (Russell *et al*, 1996) its water requirement is extremely low and it can stand long period of drought by shedding most of its leaves to reduce transpiration loss. (Heller, 1996).The plant is undemanding soil type require not tillage, grows well in low rainfall condition require only about 200mm of rain to survive and sensitive to ground. Its water requirement is extremely low and it can stand long period of drought by shedding most of its leaves to reduce transpiration loss (Heller, 1996).The plant is undemanding soil type require not tillage, grows well in low rainfall condition require only about 200mm of rain to survive and sensitive to ground frost that may occur in the cold season. In Equatorial regions where moisture is not a limiting factor i.e. continuously wet tropics or under irrigation, Jatropha can bloom and produce fruits all year. A drier climate has been found to improve the oil yields of the seeds, though to withstand times of extreme drought, Jatropha plant will shed leaves in an attempt to conserve moisture, which result in the same decreased growth (Jones and miller 1992

Economically, *Jatropha curcas* has gained considerable recognition in the mid '90's as an alternative source of fuel or lighting in low RPM diesel combustion engines. Thus, a potential source of bio-diesel for trucks and cars. Besides, about one third of the energy in the fruit of Jatropha can be extracted as oil. It has a similar energy value to diesel fuel and can meet the cooking and lighting needs of the rural population and boiler fuel for industrial purposes. Jatropha oil can be produced from locally grown Jatropha plants and its oil can be used directly in diesel engines. (Jones and Miller 1992).Being drought tolerant, it can be used to reclaim eroded areas and it as the ability to grow on marginal loud. It is used for desertification and erosion control and for preventing shifting of sand dunes. Moreover, the cost of producing Jatropha oil as a diesel substitute is currently higher than the cost of diesel itself that is either subsidize or not priced at "full cost" because of misconvered and distorted national energy polices (Trabi et al 1997). Nevertheless the environmental benefits of substituting plant oil for diesel provides for making highly desirable goals (Bun 1996).

Jatropha oil has a very high saponification value and is being extensively used for making soap in some countries. Also, the oil is used as an illuminant as it burns without emiting smoke. The latex of *Jatropha curcas* contains an alkaloid known as Jatrophine which is believed to have anti-cancerous properties. It is also used as an external application for skin disease and rheumatism and for sores on domestic livestock. In addition, the tender twig of the plant is used for cleaning teeth while the juice of the leaf is used as an external application for piles. The root is also reported to be used as an antidote for snake bites. The bark of *Jatropha curcas* yields a dark blue dye which is used for colouring cloth, fishing nets and lines (Griffiths *et al* 1989). Its leaves are used as food for the silkworm. In Brazil, the leaves are used for fumigating houses against bed bugs. It has been so successful that consideration is now been given to building a factory to produce insecticide on commercial scale. Its oil cake is rich in Nitrogen, phosphorus and potassium and can be used as Organic manure (Trabi *et al*, 1997).

Experimental site:
The experimental site is Forestry Research Institute of Nigeria (FRIN) headquarters, Jericho Ibadan. It is situated at Jericho hill under the Ibadan North West Local Government area of Oyo State. The area lies between latitude $7^{o}\ 26^{1}$ N and longitude $3^{o}\ 26^{1}$ E. The climate of the area is tropically dominated by rainfall pattern range between 1400mm-1500mm. The average temperature is about 32.2^{o} C and relative humidity is about 65% (Forest Conservation / Metrological Unit /FRIN). Forestry Research Institute of Nigeria is bounded by

residential, commercial, industrial and Agricultural centers. Open space, water bodies, government acquisition, public and semi-public land use are noticed around the region. The eco-climate of the area is rainfall with two distinct seasons which are dry season (usually commencing from November – March) and the rainy season from April – October. (FRIN Annual Metrological Report 2010).

MATERIALS AND METHODS

Jatropha curcas seeds used were extracted carefully from its shell and sun dried. Seedlings were raised inside a germination box, filled with sterilized river sand. Two weeks after germination, seedlings were transplanted into the polythene pots. There were 45 polythene pots altogether with 15 polythene pots placed under each of the tree canopies. There are three treatments (T1) seedling placed under Gmelina plantation, (T2) seedlings placed under *Bambussa vulgaris* and (T3) seedlings placed in open space near the Forestry Research Institute of Nigeria Agro-climatological Station.T3 served as control site. The initial readings of the growth parameters (stem height, stem diameter, leaf count) were taken immediately while subsequent readings were taken on a weekly basis. The experiment covered twelve weeks with eight weeks of thorough observation, measurement and reading.

Method of data analysis

Descriptive Statistic and Analysis of Variance were used to analyze the data obtained. Duncan multiple range test was used to separate the means.

RESULTS AND DISCUSSION

Table 1: ANALYSIS OF VARIANCE FOR THE HEIGHT OF *Jatropha curcas* SEEDLINGS

Source of Variance	D.F	S.S	M S	V.r	F pr.
Treatments	2	0.46	0.23	0.37	0.696NS
Error	21	13.12	0.62		
Total	23	13.58			

Note: NS- Not Significant at 5% level of probability.

The result of the analysis of Variance from Table 1 shows that there is no significant difference among the treatments at 5% probability level. Hence, Duncan multiple range test was applied for further test.

Table 2: Effects of Different Tree Canopies on the mean Height (cm) of *Jatropha curcas* Seedlings

	Weeks after Transplanting.								
Treatments	1	2	3	4	5	6	7	8	Mean
T1	18.3	19.1	19.4	19.8	19.9	20.1	20.3	20.7	19.70a
T2	18.5	17.2	19.6	19.8	20.1	20.2	20.3	20.4	19.84a
T3	17.9	18.7	19.1	19.6	19.9	20.0	20.2	20.6	19.50a
Grand Mean		19.68							
L.S.D		*0.82*							
% CV		4.0							

The Duncan Test at 5% probability level was applied. Mean of the same alphabet are not significantly different. Table of Mean showed that the T2 had the highest height with mean value of 19.84cm followed closely by T1 with mean value of 19.70cm while T3 had the least performance with mean value of 19.50cm. This agrees with Boctener and Kahod (1990) findings that stated that different tree canopies have different impact on the growth, development and distribution of plant beneath the forest. It also confirm Bertness and Callaway 1994; Callaway and Walker 1997 findings that tree canopies- seedlings interactions varies with the physical and biological environment, as well as the physiological and demographic traits of the interacting species. Hence, the relative importance of canopy effects could vary strongly depending on the characteristics of the system and the species considered.

Table 3: ANALYSIS OF VARIANCE FOR STEM DIAMETER OF *Jatropha curcas* SEEDLINGS

Source of Variance	D.F	S.S	M S	V.r	F pr.
Treatments	2	0.013	0.007	3.32	0.056NS
Error	*21*	*0.043*	*0.002*		
Total	23	0.056			

Note: NS- Not Significant at 5% level of probability.

The result of the analysis of Variance from Table 3 shows that there is no significant difference among the treatments at 5% probability level.

Table 4: Effects of tree Canopy on mean Stem Diameter (cm) of *Jatropha curcas* Seedlings

	Weeks after Transplanting.								
Treatments	1	2	3	4	5	6	7	8	Mean
T1	0.48	0.49	0.51	0.53	0.55	0.56	0.58	0.60	0.54a
T2	0.48	0.51	0.55	0.58	0.60	0.61	0.62	0.63	0.57a
T3	0.46	0.48	0.49	0.51	0.53	0.54	0.55	0.56	0.52a
Grand Mean			0.05						
L.S.D			0.04						
% CV			8.3						

Duncan multiple range test at 5% probability level was applied. Mean of the same letter are not significantly different. Table of mean shows that seedlings placed under *Bambusa vulgaris* stand had the best performance in stem diameter with mean value of 0.57mm followed by T1(placed under Gmelina arborea stand) gave stem diameter reading of 0.54mm.T3 (placed in open place) performed low with mean value of 0.52mm. This may be linked to lower radiation under *Bambessa vulgaris* and Gmelina stands which reduce soil temperature and evaporation and water losses. However, the higher organic matter content present under the two stands improves soil water retention, thereby causing soil moisture and rates of litter decomposition to be higher under tree canopy than in open areas. This support (Soriano & Sala 1986; Aguiar and Sala 1994)findings that stated that that woody species can increase soil nutrients and organic matter because of the accumulation of litter beneath their canopies. Besides, they support trapping of windblown particles or symbiotic associations with N-fixing micro-organisms (Chapin *et al*. 1994; Alpert & Mooney 1996; Escudero *et al*. 1985; DeSoyza *et al*. 1997),

Table 5: ANALYSIS OF VARIANCE FOR LEAF PRODUCTION OF *Jatropha curcas* SEEDLINGS

Source of Variance	D.F	S.S	M S	V.r	F pr.
Treatments	2	2.25	1.13	2.30	0.124NS
Error	21	10.25	0.49		
Total	23	12.50			

Note: NS- Not Significant at 5% level of probability.

According to Table 5, there is no significant difference among the treatments at 5% level of probability; hence further analysis is carried out using Duncan Multiple Range Test.

Table 6: Effects of Canopy on mean Leaf Production of *Jatropha curcas* Seedlings.

	Weeks after transplanting.								
Treatments	1	2	3	4	5	6	7	8	Mean
T1	3	4	4	4	4	5	5	5	4.25a
T2	3	4	4	5	5	5	5	6	4.62a
T3	3	4	4	4	4	4	4	4	3.88a
Grand Mean		4.25							
L.S.D			0.73						
S.E			*0.70*						
% CV			16.4						

The Duncan Multiple Range Test at 5% probability level was applied. Mean of the same alphabet are not significantly different. Table of mean showed that seedlings placed under *Bambussa vulgaris* (T2) had the highest leaf count with mean value of 4.62 followed by those placed under *Gmelina arborea* stand (T1) (4.25).However, those placed in open place (T3) had the least mean leaf count (3.88). This confirm (Jackson et al. 1990; Callaway *et al*. 1991; Belsky 1994; Pugnaire *et al*. 1996;Tirado 2003) findings which states that tree canopies of woody plants facilitate vegetation growing beneath their canopies (mainly herbaceous species) by ameliorating the physical environment and specially by increasing soil fertility. It also support (Gómez 2004; Castro *et al.* 2004a; Gómez-Aparicio *et al.* 2005).findings which state that Shade is a necessary condition for seedling establishment of several woody species

CONCLUSION AND RECOMMENDATION.

From the study carried out and based on the result of the statistical analysis, it showed that *Jatropha curcas* seedlings respond positively under different tree canopies with respect to stem diameter stem height and leaf count. This may be linked to (Franco and Nobel 1988; Valiente-Banuet and Ezcurra 1991;) findings which state that 'canopy effect' involves at least two components: microclimatic amelioration and protection from herbivores. It may also be due to the fact that understorey microclimate is characterized by lower irradiance and air temperature, and consequently lower evapotranspiration demands, than open areas without vegetation (Callaway 1992; Maestre *et al*. 2003). This also shows conformity with 1997 International Union of Forestry Research Organization findings which states that tree canopies have modulating effect on the micro-climatic condition under the forest, and directly or indirectly exert a tremendous impact on trees and seedlings production. In addition, result of the Duncan Multiple Range Test revealed that there was significant difference among the treatment at 5% level of significance. This agrees with Boctener and (Kahod 1990) findings that stated that different tree canopies have different impact on the growth, development and distribution of plant beneath the forest floor.

Therefore, from the study, it could be concluded that tree canopies has a benefited effects on seedling performance especially *Jatropha curcas* seedlings. This may be due to microclimatic amelioration due to canopy shading. Besides, there is a significantly increased in available K, which has been shown to improve seedling water-use efficiency under drought conditions. In addition, the positive respond of *Jatropha curcas* seedlings to different tree canopies is an indication that forest cover or tree canopies have blanketing effect on seedlings production. Thus, the following measures are recommended for proper raising and growth of Jatropha *curcas* seedlings at the nursery:

- Where Jatropha *curcas* are to be raised to meet the urgent need for its plantation, seedlings should be placed and raised under *Bambussa vulgaris.*

- Equally, the result of this study should be disseminated to the Silviculturist / Forester and nursery workers who intend to embark on *Jatropha curcas* plantation. This will enable them to plan ahead their activities with less prone to risk of seedlings failure.

REFERENCES

Boctener S.E and Kahod P.J. (1990): Single Tree Influence on Soil Properties in the montane of Eastern Kentucky. *Journal of Biogeaography*, Pp 12-16.

FRIN, (2008): Forestry Research Institute of Nigeria Annual Meteorological Report.

Jones, N. and Miller J. H, (1992) ; *Jatropha Curcas* a multipurpose species For problematic sites land resources – series 11:40.

Gabitz G.M, Trabi, Steiner, N, (1997): Biofuels and industrial product from *Jatropha curcas:* proceeding from a symposium held in Maragua Nicaragua, February, 1997.

Griffiths, G Leith, A., Green, M: Proteins that plays Jeky 11 and Hyde. New Scientist. 16 July, 1987 Pp 57-61.

Grimm, C. and J.M (1997) Maes. Arthroipod Fauna Associated with *Jatropha Carcus* L. in Nicaragua: A synopisis of species, their Biology and Pest Status. D-92 927:150 – 153.

Heller M. (1996): Physics nut, *Jatropha curcas* promoting the conservation, And Use of under Utilized and Neglected Crops. International Plant Genetic Institute (IPGRI), Rome Italy, pg72

International Union of Forestry Research Organization (IUFRO: Interaction between Climates and Forestry, Occasional Paper Vol. 9, 1997.

Russel, A. and Webbi, C. F. (1996): The ecological requirement of *Jatropha Curcas* _ National History Museum Conwell road London, SW 75 BD pp 50.

Zinke .P.J. (1962): The Pattern of Influence of Individual Forest Trees on Soil Properties Bertness, M.D. & Callaway, R.M. (1994). Positive interactions incommunities. *Trends Ecol. Evol.* 5: 191-193.

Gómez-Aparicio, L., Zamora, R. & Gómez, J.M. (2005). Regeneration status of the endangered *Acer opalus* subsp.*granatense* throughout its geographical distribution in the Iberian peninsula. *Biol. Conserv.* 121: 195-206.

Callaway, R.M. . & Greenlee, J.T (1996). Abiotic stress and the relative importance of interference and facilitation in montane bunchgrass communities in western Montana. *Am. Nat.* 148: 386-396.

Callaway, R.M., Nadkarni, N.M. & Mahall, B. (1991). Facilitation and interference of *Quercus douglasii* on understory productivity in central California. *Ecology* 72: 1484-1499.

Soriano, A. & Sala, O.E. (1986). Emergence and survival of *Bromus setifolius* in different microsites of a Patagonian arid steppe. *Isr. J. Bot*. 35: 91-100.

Jackson, L.E., Coimbra, PT. Strauss, R.B., Firestone, M.K. & Bartolome, J.W. (1990) Influence of tree canopies on grassland productivity and nitrogen dynamics in deciduous oak savanna. *Agr. Ecosyst. Environ.* 32: 89-105.

Callaway, R.M. & Walker, L.R. (1997). Competition and facilitation:A Synthetic approach to interactions in plant communities. *Ecology* 78: 1958-1965.

Franco, A.C. & Nobel, P.S. (1988). Interactions between seedlings of *Agave deserti* and the nurse plant *Hilaria rigida. Ecology* 69: 1731-1740.

Callaway, R.M. (1992) Effect of shrubs on recruitment of *Quercusdouglasii* and *Quercus lobata* in California. *Ecology* 73: 2118-2128.

Belsky, A.J. (1994). Influences of tree on savanna productivity: test of shade, nutrients, and tree-grass competition. *Ecology* 75: 922-932.

Gómez, J.M. (2004). Importance of burial and microhabitat on *Quercus ilex* early recruitment: non-additive effects on multiple demographic processes. *Plant Ecol.* 172: 287-297.

Gómez-Aparicio, L., Zamora, R., Gómez, J.M., Hódar, J.A.,Castro, J. & Baraza, E. (2004).Applying plant facilitation to forest restoration in Mediterranean ecosystems: a metaanalysis of the use of shrubs as nurse plants. *Ecol. Appl.* 14, 1128-1138.

Gómez-Aparicio, L., Zamora, R. & Gómez, J.M. (2005). Regeneration status of the endangered *Acer opalus* subsp.*granatense* throughout its geographical distribution in the Iberian peninsula. *Biol. Conserv.* 121: 195-206.

Jackson, L.E., Strauss, R.B., Firestone, M.K. & Bartolome, J.W. (1990). Influence of tree canopies on grassland productivity and nitrogen dynamics in deciduous oak savanna. *Agr. Ecosyst. Environ.* 32: 89-105.

Castro, J., Zamora, R., Hódar, J.A. & Gómez, J.M. (2004a).Seedling establishment of a boreal tree species (*Pinus sylvestris*) at its southernmost distribution limit, consequences of being in a marginal Mediterranean area. *J. Ecol.*92: 266-277.

Maestre, F.T., Bautista, S. & Cortina, J. (2003). Positive, negative, and net effects in grass-shrub interactions in Mediterranean semiarid grasslands. *Ecology* 84: 3186-3197.

Tirado, R. (2003). Interacciones positivas entre plantas: mecanismos y consecuencias. Ph.D. Thesis, University of Sevilla, ES.

Pugnaire, F.I., Haase, P., Puigdefábregas, J., Cueto, M., Clark, S.C. & Incoll, L.D. (1996). Facilitation and succession under the canopy of a leguminous shrub, *Retama sphaerocarpa*, in a semi-arid environment in south-east Spain. *Oikos* 76: 455-464.

Joffre, R. & Rambal, S. (1993). How tree cover influences the water balance of Mediterranean Rangelands. *Ecology* 74: 570-582.

DeSoyza, A.G., Whitford, W.G., Martinez-Meza, E. & VanZee, J.W. (1997). Variation in creosote bush (*Larrea tridentata*)canopy morphology in relation to habitat, soil fertility and associated annual plant communities. *Am. Midl. Nat.* 137: 13-26.

Escudero, A., García, B., Gómez, J.M. & Luis, E. (1985). The nutrient cycling In *Quercus rotundifolia* and *Q. pyrenaica* ecosystems of Spain. *Oecol. Plant.* 6: 73-86.

Alpert, P. & Mooney, H.A. (1996). Resource heterogeneity generated by shrubs and topography on coastal sand dunes. *Vegetatio* 122: 83-93.

Chapin, F.S., Walker, L.R., Fastie, C.L. & Sharman, L.C. (1994).Mechanisms Of primary succession following deglaciationat Glacier Bay, Alaska. *Ecol. Monogr.* 64: 149-175.

Received for Publication: 08/06/2011
Accepted for Publication: 30/07/2011

Corresponding author
Adeoye O.K
Federal College of Forestry Ibadan, Nigeria
Email: adeoyekayode2000@yahoo.com