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INFLUENCE OF MICROCLIMATIC ELEMENTS ON THE EARLY GROWTH OF JATROPHA (*Jatropha curcas* (Linn)) SEEDLINGS IN KANO, NIGERIA

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ABSTRACT
This study examined the influence of Microclimatic elements on the early growth of Jatropha curcas Seedlings in Kano, Nigeria. The experiment was conducted between 20 April, 2014 and 14 July, 2014. Temperature and Humidity values were recorded using two Lascar EL- USB data loggers one at each of the two treatments (shade and sun). Early growth characteristics of J. curcas seedlings were recorded at 2, 4, 6, 8, 10 and 12 weeks after sowing (WAS). Table was used to show the early growth characteristics of J. curcas. Pearson's Product Moment Correlation was used to test whether there is significant relationship between the microclimatic elements and the early growth characteristics of J. curcas seedlings. The test was carried out at 0.05 significant levels. The Correlation result showed that there is a significant relationship between the microclimatic elements and the early growth characteristics of J. curcas seedlings in the sun treatment however; it showed that there is no significant relationship between the microclimatic elements and the early growth characteristics of J. curcas seedlings in the shade treatment. Finally, it is concluded that microclimatic elements influences the early growth characteristics of J. curcas seedlings nurtured in the sun as such farmers or entrepreneur should raise the specie seedlings in the sun for large scale productions.
Key words: Humidity, Early growth, Jatropha curcas and Temperature

INTRODUCTION

Air temperature and relative humidity are two key meteorological parameters that influence plant growth. Temperature is directly linked to metabolic rates and relative humidity influence plant's loss of water due to transpiration to fix a certain amount of carbon dioxide (CO_2). The water vapour content of the air directly affects the atmospheric evaporative demand on seedlings and, therefore, the seedling transpiration rate. Prolonged high evaporative demand for moisture can cause seedling water stress and a subsequent reduction of growth (Von Arx, Dobbertin and Rebetez, 2012). Physiological processes such as photosynthesis and respiration involve biochemical reactions that are temperature-dependent (Spittlehouse and Stathers, 1990).

Jatropha curcas is a small tree or shrubs with smooth gray bark which extrudes whitish coloured watery latex when cut. It is commonly refered to as physic nut or American purging nut. In Nigeria, it is called *Bini da Zugu* in Hausa," *odo- ala*" in Igbo and "*Lapalapa or Botuje*" in Yoruba (Adeoye, *et al.*, 2011). It belongs to the family of *Euphorbiaceae* which normally grows in the tropics. It can grow almost anywhere and it is a drought resistant and perennial crop. It is easy to establish, grows relatively quickly and lives for 40-50 years. Its productive life is from 30- 40 years. It is resistant to drought and produce seeds containing 32-40 % oil. When the seeds are crushed and processed, the resulting oil can be refined to diesel engine, while the residue can also be processed into biomass to power electricity plants and organic fertilizer and it is one of the best plants for future bio-diesel production (FACT Foundation, 2010). Jatropha is a genus of 175 succulent perennial shrubs or small trees which can attain heights of more than 5 metres, depending on the growing conditions with spreading branches and stubby twigs. Some of the species of Jatropha include: *J. integerrima, J. elliptica, J. cuneata, J. macranth, J. pandurifolia, J. cardiophylla, J. podagrica, J. multifida, J. cathartica,* and *J. curcas* to mention a few (Raju and Ezradanum, 2002 cited FAO, 2010).

MATERIALS AND METHODS

The Study Area

The experimental site is Shelterbelt Research Station Kano situated on latitude 12° 1'42.20''N and longitude 8°30'19.06''E (Figure1)". The area falls under the tropical wet and dry type coded as Aw based on the Koppen's classification of climate with mean annual rainfall of about 884mm and the temperature ranges from 21°C to 31°C (Olofin, 2013).

Study Period, Experimental Design and Detailed Field/ Nursery Work

The study covered a period of twelve (12) weeks (20 April to 14 June, 2014). Data on the number of days to seedlings emergence, plant height, stem diameter, leaf area, number of leaves per plant, fresh weight per plant, dry weight per plant and crop growth rate (CGR) per plant were measured. Temperature and Humidity were recorded during the study period. A total of 90 polyethene pots were produced, 45 placed in the shade and another 45 placed in the Sun. The experiment was laid out in a completely randomized design (CRD) with six repetitions at 2, 4, 6, 8, 10 and 12 weeks after sowing the *J. curcas* seeds.

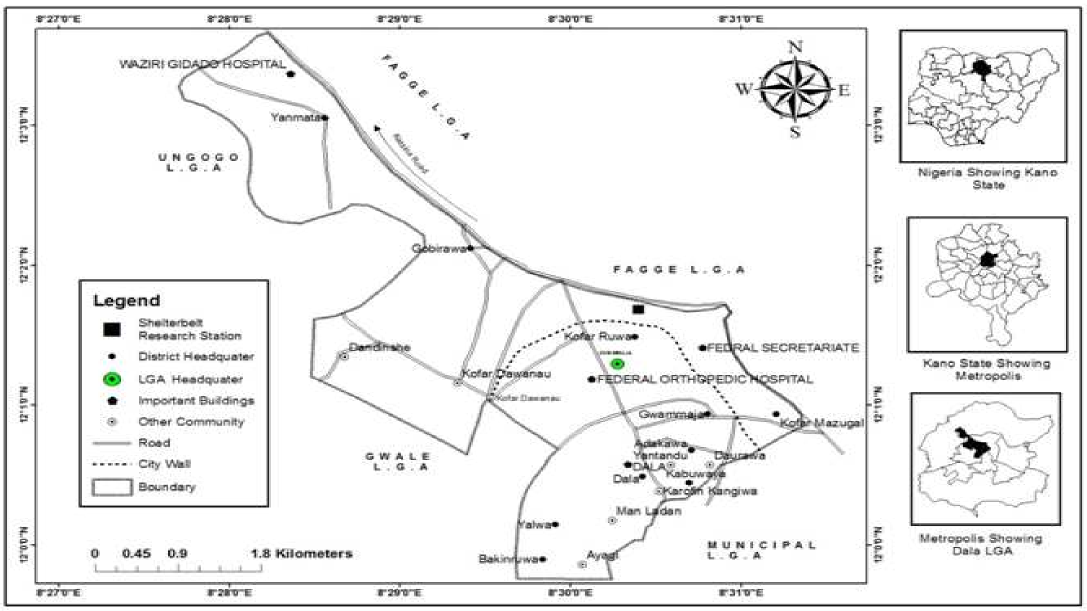

Figure 1: Dala Local Government Area Showing the Experimental Site
Source: Adopted from Kano Urban Planning Development Agency (2005)

Two Lascar EL- USB Temperature/Relative Humidity Data Loggers were programmed and raised 1.2m above the ground one at each treatment (shade and sun) to sample Temperature and Humidity at every six hours. Similarly, fresh untreated *J. curcas* seeds were collected from Shelterbelt Research Station, Kano. Two seeds per pot were sowed at 2cm depth directly in to 10 x 20cm polythene pots containing potting mixture of sand, soil and farm manure in the ratio of 1:1:2 by volume which were later thinned to one seedling at two weeks after sowing (2 WAS) as recommended by Abubakar (2010). The seedlings were irrigated in the morning on daily basis. The early growth characteristics (Number of days to seedlings emergence, plant height, stem diameter, leaf area, number of leaves per plant, fresh weight per plant, dry weight per plant and crop growth rate (CGR) per plant) were also measured as follows. Number of days to seedling emergence was recorded from the date of sowing to when the final seedling emerged. Plant height was determined from five tagged plants at 2, 4, 6, 8, 10 and 12 weeks after sowing. Each plant was measured from its base to the terminal bud using a meter rule. Stem diameter was measured using a digital vernier caliper. Each plant was measured at 2cm from its base. Leaf area was measured using leaf area meter. Number of leaves per plant was determined by counting the number of leaves of five tagged plants and dividing the total number by five at 2, 4, 6, 8, 10 and 12 weeks after sowing. Fresh weight per plant was determined by uprooting five sampled plants and weighed using an electronic weighing balance (ADP 3100L) with capacity readability of 3100g / 0.01g. The total weight was later divided by five to obtain the mean.

Dry weight per plant was determined using an electronic weighing balance (ADP 3100L) with capacity readability of 3100g / 0.01g after oven drying the above five sampled plants at 70° C to a constant weight for 6 hours at 2, 4, 6, 8, 10 and 12 weeks after sowing and the mean was recorded (Adamu, 2014). Crop growth rate (CGR) per plant was determined by using Watson (1958) formula as follows:

$$\mathrm{CGR} = \frac{W2 - W1\ \left(\frac{g}{week}\right)}{T2 - T1}$$

Where: W_2 – W_1 = differences in dry weight and T_2 -T_1 = differences in times

RESULTS AND DISCUSSION

Mean early growth parameters of *Jatropha curcas* seedling is shown in Table 1.

Table 1. Shade and Sun Mean Early Growth Characteristics of *J. curcas* Seedlings' Data

Characters	Treatments	Weeks After Sowing							
		2	4	6	8	10	12	Mean	SD
Height (cm)	Shade	13.5	16.7	20	24.1	27.1	38.3	23.3	8.8
	Sun	12.7	19	27.9	39.1	51.7	70.2	36.8	21.5
Stem diameter (cm)	Shade	0.5	0.5	0.6	0.7	0.8	1.1	0.7	0.2
	Sun	0.5	0.6	0.7	1.2	1.4	1.8	1.0	0.5
Leaf area (cm^2)	Shade	28.4	34.8	38.8	39.9	41.7	43.2	37.8	5.4
	Sun	21.8	35.7	42.1	45.5	48.8	61.5	42.6	13.3
Leaf count	Shade	3.2	5.2	8.4	10.6	13.4	18.2	9.8	5.5
	Sun	3.4	5.8	11.4	15.8	21.4	32.2	15.0	10.7
Fresh weight (g)	Shade	4.9	7.9	14.2	23	30	69.7	25.0	23.8
	Sun	4.9	13.6	28.6	71.1	136.4	259.6	85.7	98.0
Dry weight (g)	Shade	0.4	0.8	1.8	3.1	6.5	13.8	4.4	5.1
	Sun	0.4	1.5	3.9	10.9	31.9	55.9	17.4	22.2
Crop growth rate (g/wk)	Shade	0.2	0.2	0.5	0.7	1.7	3.7	1.2	1.4
	Sun	0.2	0.6	1.2	3.5	10.5	12	4.7	5.2

From Table 1, it can be observed that early growth characteristics of *J. curcas* seedlings increase with increase in number of weeks, the plant height increases from 13.5cm in the shade and 12.7cm in the sun at 2WAS to 38.3cm in the shade and 70.2cm in the sun treatment at 12WAS so also the other early growth parameters. Fresh weight in the sun had the highest mean of 85.7 and the highest standard deviation of 98.0. The lowest mean and standard deviation of 0.7 and 0.2 was observed in the shade' stem diameter.

Early growth parameters of *J. curcas* (Table 1) corroborates that of Adeoye *et al*. (2011) as they also found out that *J. curcas* seedlings placed in the sun gave the best performance in terms of plant height and stem diameter however, it contradicts their findings on leaf count as their study revealed that *J. curcas* seedlings placed under *Bambussa vulgaris* canopy gave better performance in terms of leaf count than those in the sun treatment. The study also agrees with the findings of Geiger, Aron and Todhunter (2009) that canopy and tree stems partly shield near ground areas from solar radiation and reduce mixing of air. As a consequence, below-canopy microclimate may substantially differ from comparable open areas; hence this might be the cause of the difference in early growth characteristics of *J. curcas* between the seedlings in the shade and those in the sun treatment.

The relationship between microclimatic elements and the early growth characteristics of *J. curcas* seedlings in the shade treatment is presented in Table 2.

Table 2. Relationship between Microclimatic Elements and the Early Growth Characteristics of *J. curcas* Seedlings in the Shade Treatment

Jatropha Characteristics	Temperature	Humidity
Height	*0.451*	*-0.458*
Stem Diameter	*0.47*	*-0.467*
Leaf Area	*0.55*	*-0.575*
Leaf Count	*0.543*	*-0.548*
Fresh Weight	*0.373*	*-0.367*
Dry Weight	*0.384*	*-0.354*
Crop Growth Rate	*0.380*	*-0.921*

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There is no significant relationship between microclimatic elements and the early growth characteristics of *J. curcas* seedlings in the shade treatment at both 0.05 and 0.01 significant levels (Table 2). This result is not far from the findings of Baumgaart, (2007), cited Jongschaap, *et al*, (2007) as they reported that Jatropha is well adapted to conditions of high light intensity and is unsuited to growing in shade. This might be the reason for the Table 2 result.

The result of the relationship between microclimatic elements and the early growth characteristics of *J. curcas* seedlings in the sun treatment is shown in Table 3.

Table 3. Relationship between Microclimatic Elements and the Early Growth Characteristics of *J. curcas* Seedlings in the Sun Treatment

Jatropha Characteristics	Temperature	Humidity
Height	*- 0.833**	*0.946***
Stem Diameter	*- 0.829**	*0.935***
Leaf Area	*-0.797*	*0.861**
Leaf Count	*- 0.831**	*0.951***
Fresh Weight	*- 0.896**	*0.992***
Dry Weight	*- 0.887**	*0.986***
Crop Growth Rate	*- 0.805**	*0.921***

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

From Table 3, it can be observed that there is significant relationship between microclimatic elements and the early growth characteristics of *J. curcas*. The relationship however, is more significant between humidity and the early growth characteristics of *J. curcas* than between temperature and the early growth parameters. This result corroborates with the findings of Spittlehouse and Stathers (1990) as they also found out that there is a significant relationship between microclimatic elements and seedlings establishments. It is also similar to that of Wicklein, *et. al*. (2012) who reported that favourable temperature, air humidity and soil moisture are crucial determinants for a survival and growth of young tree seedlings.

These findings emphasized the importance of Sun light on plants generally because it has revealed how seedlings nurtured in the sun grow faster than their shade counterparts; specifically, the results have revealed that *J. curcas* plant is well adapted to high light intensity conditions and is unsuited to growing in shade (Table 1). The findings are also not far from the findings of Baumgaart, (2007), cited Jongschaap, *et al*, (2007).

CONCLUSION

Microclimatic elements affect seedlings' early growth characteristics by increasing the rate of growth, plant height, stem diameter, and leaf count. *Jatropha curcas* seedlings nurtured in the sun grows faster than their shade counterparts due to the vital role played by sunlight during photosynthesis and other growth processes.

These findings revealed that there is a significant relationship between microclimatic elements and plant height, stem diameter, leaf count, fresh weight, dry weight and crop growth rate in the sun and there is no significant relationship between microclimatic elements and the early growth characteristics in the shade. Information obtained from this paper will be adopted by farmers or entrepreneur for large scale production of the specie seedlings and maximizing its potentials for various uses.

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