Efficacy of water lettuce mulch as Biostimulant in *Jatropha curcas* Grown in a crude oil Contaminated Soil

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Abstract: The efficacy of water lettuce mulch in growth promotion and toxicity reduction in an oil contaminated soil using Jatropha as a test crop was explored at the teaching and research farm, Ignatius Ajuru University of Education, Port-Harcourt. A randomized complete block (RCBD) design with three treatments -Jatropha polluted with crude oil (JC), Jatropha polluted with crude oil and amended with water lettuce mulch (JCW) and Jatropha planted alone (JA) was used, with each treatment replicated three times. Each seedbed was applied with 3.3 litres of crude oil, while 50g of water lettuce mulch was added on treatments with amendment (JCW). Growth indices used were germination percentage, mean height, leaf number and oil concentration. Data was analysed at intervals, using mean, simple percentage and analysis of variance. Results showed phototoxic nature of crude oil and its reduction and growth promotion with presence of water lettuce mulch.
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Introduction

The world over today has acknowledged Jatropha as a promising bio-fuel crop necessary in conversion of today's unproductive land into tomorrows green oil fields. Its importance as a substitute to diesel, reducing world dependence on oil imports and saving foreign exchange aside from providing much needed energy security has created awareness on its cultivation in plantations (El Gamasy, 2008). Apart from its environmental benefits, the crop can assist in afforestation and fight against desertification when planted along, inform of hedges in some frontline states in Northern Nigeria. (Belewu and Orire 2011). The kernels consist of 60% oil which can be transformed through esterification to diesel whereas the green energy of the plant can be used to power machines. (Mondal *et al.,* 2008).

From literature, about 5million hectares of *Jatropha curcas* are being established on a worldwide scale scattered in most countries (EL Gamessy 2008). In Nigeria, efforts are being made by the Government to support investment in Jatropha cultivation. For example the Nigeria National petroleum company (NNPC) was reported to have introduced guaranteed price to a targeted 100,000 ha of Jatropha cultivation (Gexsi, 2008). In follow-up, any attempt to boast research that will encourage its cultivation is a welcome development.

Water lettuce, an aquatic macrophyte has been known to constitute nuisance to users of water ways, sea, rivers, lakes e.t.c. Its use as a mulch material is expected to exact qualities inherent in Organic materials. Organic mulch in recent times has been used to prevent ground water pollution, caused by inorganic manure; its nutrients are slowly released in a more natural way. It tends to improve soil structure by enhancing its moisture retention capacity and long term fertility with relative impact on erosion control and carbon sequestration; hence the use of organic manure arising from water lettuce mulch could help in restoration of contaminated soil for optimum Jatropha cultivation.

Materials and Methods

The experiment was carried out at the teaching and research farm, Ignatius Ajuru University of Education Port-Harcourt. The land used was kept follow for two to three years. The experiment was carried out in a plot of land, each plot measuring 8x8m, laid out in a randomized complete block design (RCBD) with three treatments replicated three times. The treatments are as follows:

- Jatropha Curcas + Crude oil = JC
- Jatropha Curcas + Crude oil + Water lettuce mulch=JCW
- Jatropha curcas alone = JA

Seeds of Jatropha curcas were purchased from a local farmer at Ogoni, Gokana Local Government Area of River- state, while the crude oil was procured from the Nigerian Agip oil (Bonny type) Ebocha base Port-Harcourt. The experimental plot was polluted at the rate of 3.3 litres in each bed. Application of water lettuce mulch was carried out a week after contamination of the soil with crude oil at the rate of 50g per seed bed. Weeding was done manually, three times throughout the experimental period.

Growth Evaluation

(a) Germination percentage: Germination percentage was evaluated at four to twelve days after planting and was recorded and calculated as follows:

Germination percentage-

$$\frac{No\ of\ Seeds\ germinated \times 100}{No\ of\ Seeds\ planted}$$

(b) Plant height

Height of plant was taken by use of metre rule from the collar region to the terminal leaf of the plant. Five plants were randomly tagged in each experimental unit. The measurement was taken three times at 20, 40 and 60 days respectively during the experimental period.

(c) Leaf count: The leaves per plant were randomly tagged, counted, and recorded from the five tagged plant stands.

(d) Oil concentration: This was determined using the method of USEPA 1991, four times during the experimental period. For the extraction of hydrocarbons, one gram of soil samples was delivered into 10 ml of chloroform in an extraction flask. The mixture was shaken vigorously for two minutes and allowed to stand for the soil particle to settle out of solution.

The oils was extracted and determined by the absorbance of the extract at 420nm in a Sp6 Pye unican Spectrophmeter. A different known concentration of equal amounts of crude oil in the extractant was first drawn after taken readings from the spectrophotometer. The standard curve was used to estimate the oil concentration after multiplying by an appropriate dilution factor.

(e) Data analysis: Data analysis on germination, plant height and leaf number was done using simple percentage and mean while oil concentration was analyzed using analysis of variance and treatment mean compared using the least significant difference (LSD) option at 0.05% probability level.

Results and Discussion

The result on germination percentage of Jatropha curcas grown in an oil contaminated soil, amended with water lettuce mulch are presented in Fig 1. From the result, Treatments-(Jatropha + crude oil) gave germination percentages of 4.0%, 15%, and 20.0% at, 4, 8 and 12days respectively, while amendment with water lettuce mulch (Jatropha + Crude oil + water lettuce (JCW) recorded 8.0%, 22.0% and 30.0% at the same interval of days. Treatment without amendments and crude oil (Jatropha alone JA) gave higher germination percentage at 4, 8 and 12days at the rate of 15.0%, 26.0% and 32.0% compared to other treatments.

On the mean height of crop, Fig II, treatments with water lettuce mulch (JCW) recorded highest height of the plant than without amendments and when planted alone. The result on leaf number Fig III also followed with a higher leaf number being observed in treatments with amendments (JCW), seconded by Jatropha planted alone. (Without pollution and amendments):

The oil concentration, (Table1) showed a corresponding decrease in all treatments with time. However, treatment with amendment (JCW) gave higher significant oil reduction when compared with other treatments at $p<0.05$.

This study has added an interesting data to our previous works (Offor and Ouwugbuta, 2011) with respect to germination and growth characteristics in plants. The bio-stimulatory role exhibited by water-lettuce mulch in growth promotion (plant height, leaf number and germination percentage) may by as a result of effective micro-organism (EMO) and other profile bacteria in the mulch materials which accelerated the production of phyto hormone like auxins and gibberellins, this in turn must have stimulated the growth characters as supported by xue *et al.* (2000) and Hartwigsan and Evans (2000).

It has also been reported that organic manure (water-lettuce mulch) influences plant growth by modifying the physiology of plants and by improving the physical, chemical and biological properties of soil (offor and Onwugbuta 2011, Amakiri and Onofeghara 1994, Raja *et al* 2006). The result on germination inhibition in treatments without amendment (JC) is then expected, as Amakiri and Onofeghara 1994, pointed out that germination inhibition in crops is possible with presence of crude oil due to the physiological and chemical characteristics of the crude oil.

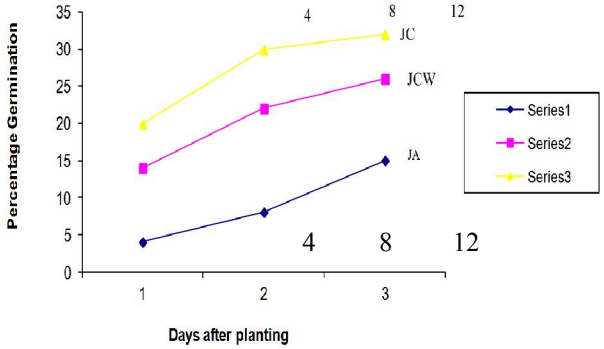

Fig I: Effect of water lettuce mulch on germination percentage of *Jatropha curcas* in a crude oil contaminated soil

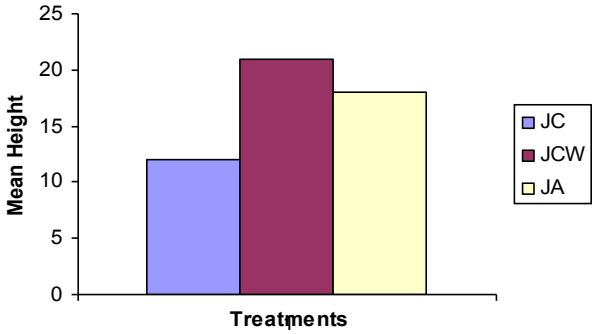

Fig II: Effect of water lettuce mulch on height of *Jatropha curcas* in a crude oil contaminated soil

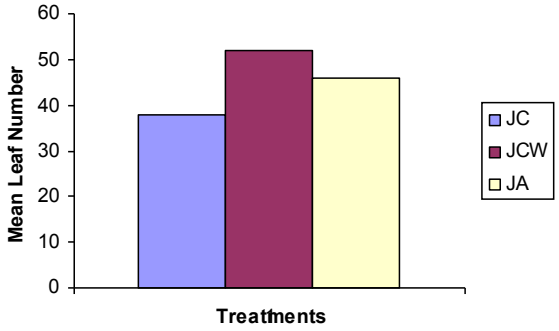

Fig III: Effect of water lettuce mulch on mean leaf number of *Jatropha curcas* in oil contaminated soil

Table 1: Effect of water lettuce mulch on oil concentration in soil planted with *Jatropha curcas*

S/N0	**JC** (ppm)	**JCM** (ppm)	**JA** (ppm)
1.	$95.02+10.30^{a}$	87.01 ± 11.12^{b}	10.01 ± 5.21^{c}
2.	92.03 ± 0.78^{a}	76.08 ± 110.11^{b}	9.00 ± 4.08^{c}
3.	76.6 ± 10.21^{a}	46.01 ± 11.01^{b}	5.01 ± 10.18^{c}
4.	$72.1\pm10.^{11a}$	19.06 ± 11.18^{b}	5.02 ± 0.07^{c}

Mean abc with different superscripts and significantly different at $p<0.05$.

From the study, oil degradation showed higher significant reduction in treatments with water lettuce mulch than others. This could be deduced with the assimilable qualities of the degrading material (water lettuce mulch) associated with its higher microbial activities which in turn breakdown hydrocarbon molecules. (Armstrong, 1978). The slight decrease in oil concentration observed in other treatments is expensed since oil degradation can take place even without remediation materials with time. (Offor and Akonye, 2006).

This study concluded that water lettuce mulch is an effective material in soil amendment and can promote growth in plants.

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