

# Germination response of *Jatropha curcas* L. seeds as influenced by crude oil in soil.

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A study was conducted in 2010 at the Research farm of the Department of Forestry and Wildlife, Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria to assess the germination response of *Jatropha curcas* seeds as influenced by crude oil in soil using crude oil levels of 0.0, 2.0, 4.0, 6.0, 8.0 and 10.0 % w/w. The seeds were planted in the soil – crude oil- mixture in bottom perforated polypots. The experiment was arranged in a randomized complete block design and replicated four times. The results showed that contamination of soil with crude oil significantly ( $P \geq 0.05$ ) reduced the percentage germination, increased days to germination and reduced rate of germination of the test plant relative to the seeds planted in the uncontaminated soils and the effects of the germination parameters were generally oil concentration dependent. No germination was observed in *J. curcas* seeds sown in 10.0 % of the crude oil. This study has demonstrated that soil contamination with crude oil has significant effects of reducing the germination spouse of *J. curcas*.

**Keywords:** Seedily emergence, *Jatropha curcas*, contaminated soil, crude oil.

## Introduction

*Jatropha curcas* is a drought – resistant perennial growing well in marginal soils. Commonly called physic nut and belonging to the Euphorbiaceae family, the shrub originated in the Caribbean, central American and was spread by Portuguese traders as a valuable hedge plant via the Cape Verde Islands and Portuguese Guinea to countries in Africa, Asia and India (Tigere *et al.*, 2006). *J. curcas* is botanically characterized with smooth gray bark, which exudes a whitish coloured, watering latex when cut. It attains a height of between 3 and 10 meters. The leaves are large green to pale green, alternate to sub-opposite, three-to-five lobed with a spiral phyllotaxis. Flowers are formed terminally, individually with the female slightly larger. Each inflorescence yields a bunch of approximately 10 ovoid fruits and the seeds become mature when the capsule changes from green to yellow after about three months. The plant is deciduous; flowering occurs mainly during the wet season but may occur throughout the year in permanently humid regions (Wini *et al.*, 2006; Achten *et al.*, 2008; Kumar *et al.*, 2008a).

*J. curcas* is a valuable multipurpose crop to alleviate soil degradation, desertification and deforestation which can also be used for bio-energy to replace petrol diesel, soap production and environmental protection. It can help to increase rural income, self-

sustainability and alleviate poverty for women, the elderly, children, men, tribal communities, rural farmers from plantation and agro forestry. The roots recycle nutrients and reduce possibility of erosion and improve soil structure and quality. The plant is attractive to investors because of the biological features of the seed oil: low acid and good oxidation stability as compared to Soya oil. *J. curcas* is used as hedging plants to protect agriculture and livestock; in parts of Africa as grave markers, in oil lamps, working stoves, as insecticides, as soaps, organic fertilizer because of the high concentration of nitrogen. The wood and seed cake can be used as firewood or charcoal. The plant is also used as a natural pesticide because of its toxicity. *J. curcas* has also been used as antidote, natural remedy, medicine and potential source of herbal drugs in dental complaints and against constipation. The milky sap is used for the treatment of dermato-mucosal diseases. The leaves are used to make tea to treat malaria and the sap to stop breeding. *Jatropha* as biodiesel tree and a renewable fuel tree may lead developing countries like Nigeria in reducing emission from fossil fuel and reduce deforestation, improving energy efficiency and transforming urban transport. Such approach can simultaneously support economic recovery and encourage growth in areas that mitigate the impact of climate change as well as reducing dependency on imported oil. *J. curcas* is capable of out-competing weeds

and its toxicity deters livestock thereby, requiring less attention as compared to other trees (Kumar *et al.*, 2008b).

Crude oil and its refined products account for over 90% of Nigeria's national income and oil spillage constitutes the most significant source of oil pollution in the Niger Delta region of Nigeria. Oil spills destroy farmlands and have significant effects on plant growth and consequently, their yields. Although studies have been conducted on the susceptibility of crop plants, tree species and microbes (Anoliefo and Edegbai, 2000; Anoliefo and Vwioko, 2001; Agbogidi *et al.*, 2006; Anoliefo *et al.*, 2006; Agbogidi, 2009; Ogbo, 2009) to crude oil, there is paucity of documented information on the germination response of this multipurpose species to oil effects. The present study has been undertaken to evaluate the germination response of *Jatropha curcas* as influenced by crude oil contamination of soil.

## Materials and Methods

The study was conducted in 2010 at latitude 6°14'N and longitude 6°49'E at the Research Farm of the Department of Forestry and Wildlife Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria (Asaba Meteorological Office, 2010). Fruits of *J. curcas* were collected from the mother tree in Anwai (Asaba). Loamy soil as a pooled sample was collected from the Gmelina plantation. The soil was air-dried and passed through a 2mm sieve. The seeds were depulped and planted without pre-treatment. The crude oil was sourced from the Nigeria National Petroleum Corporation (NNPC), Warri, Delta State, Nigeria and applied at 0, 2.0, 4.0, 6.0, 8.0 and 10.0% (w/w). The soil-crude-oil mixture was poured into bottom-perforated polypots (15x10cm in dimension). Five seeds were planted per polypot and watered immediately and subsequently, one every other day. Each treatment was represented by 10 polypots. The experiment was laid out in a randomized complete block design and replicated four times. The experiment lasted for about 11 days. It was terminated immediately the seeds germinated. Parameters measured were germination percentage, days to germination and rate of germination. Composite soil samples were collected from 0–20cm depth prior to treatment application and at the end of experiment and

used to determine soil physico-chemical properties such as soil pH, texture, nutrients water holding capacity, moisture, bulk density and structure. Similarly, the characteristics of the crude oil used were determined in NNPC laboratory, Warri, Delta State Nigeria prior to experimentation. Data obtained were subjected to analysis of variance while significant means were separated with the Duncan's multiple range tests using SAS (2005).

## Results and Discussion

Table 1 shows the soil physico-chemical properties before experimentation. The soil is sandy loam in texture with characteristics of 94.5% (sand), 2.1% (silt) and 3.4% (clay). The pH 5.60 indicated that the experimental site is slightly acidic. Both the organic matter (2.64g/kg) total nitrogen (0.06%) is relatively low. The characteristics of the crude oil used are presented in Table 2. The oil contains the major nutrients including carbon, nitrogen, sulphur, hydrogen, oxygen and trace metals in varying quantities.

Contamination of soil with crude oil significantly ( $P \geq 0.05$ ) reduced the percentage germination, increased days to germination and reduced rate of germination of *J. curcas* seeds relative to the seeds grown in the uncontaminated soils. The reduction was generally oil concentration dependent. No germination was observed in *J. curcas* seeds sown in 10.0% w/w of the crude oil (Table 3). These findings agree with prior reports of Vwioko *et al.* (2006), Sharifi *et al.* (2007) and Agbogidi (2009) on castor oil, other plants and *Gmelina arborea* respectively. The inhibitory effects of crude oil has been shown to include one or a combination of the following factors: loss of seed viability, oil coating of seeds, adulterated soil physical, chemical and microbial structure due to oxygen tension, presence of heavy metals, nutrient immobilization, disruption in the soil-water-interrelationship, penetration of oil components into the embryo, interference in the seed metabolic activities as well as interference with water and nutrient supply. This study has shown that soil contamination with crude oil has significant effects of reducing the germination response of *J. curcas* by its susceptibility to this contaminant. This study is very important analysis because it is the first event of the adaptation of plant species to contaminated soils and very important concerning to this tolerant species.

**Table 1. Physico-chemical properties of soil before experimentation**

Parameters	Asaba
Sand (%)	94.5
Silt (%)	2.1
Clay (%)	3.4
Soil pH	5.60
Textural class	Sandy loam
Organic carbon (%)	0.91
Organic matter (gkg <sup>-1</sup> )	2.64
Total N (%)	0.06
Available P (mg/kg)	30.00
Ca <sup>2+</sup> (cmol/kg)	1.31
Mg <sup>2+</sup> (cmol/kg)	0.16
Na <sup>+</sup> (cmol/kg)	0.25
K <sup>+</sup> (cmol/kg)	0.17
H <sup>+</sup> (cmol/kg)	0.45
Al <sup>3+</sup> (cmol/kg)	0.08
ECEC (cmol/kg)	2.42
Base saturation (%)	78.10

**Table 2. Characteristics of the crude oil used**

Parameters	Asaba
Specific gravity (cm <sup>-3</sup> )	0.8334
API gravity	34.2897
Bottom temperature (°C)	98.0
Viscosity (cp)	0.27
Gas oil ratio	881
Reservoirs' depth (m)	2556
Carbon (%)	84.8
Hydrogen (%)	12.61
Sulphur (%)	1.48
Nitrogen (%)	0.48
Oxygen	0.50
Trace metals (%)	0.13

**Table 3. Germination response of *Jatropha curcas* seeds as influenced by crude oil in soil**

Oil in soil %w/w	Germination %	Days to germination	Rate of germination
0.0	100.0a	8.7a	5.0a
2.0	93.6b	10.7b	4.1b
4.0	76.4c	11.2c	3.0c
6.0	51.7d	14.5d	2.1d
8.0	30.8e	17.3e	0.0e
10.0	0.0f	0.0f	0.0f

Means with different letters are significantly different ( $P \leq 0.05$ ) using the Duncan's multiple range tests (DMRT)

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