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Effect of Soil Fertility on Growth of *Jatropha curcas* L. in Ambikapur CG India.

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Abstract

Jatropha curcas L is cultivated in the fertile soil of the college's botanical garden with proper manure and fertilizers and in disturbed soil of the college's campus ground without any manure and fertilizers. The drainage system is maintained properly for both types of soils. The seeds of *Jatropha curcas* L collected from the same mother plant from Ambikapur forest, are shown in the month of July at 40 degrees C temperature. The selection of showing spots is kept so that, irrigation, protection, light, and precipitation fall might be maintained the same. Their growth rates are comparatively studied.

Key words: *Jatropha curcas* L, Comparative- productivity, Soil fertility, Soil Pollution, Bio-diesel, Bio-fuel .

I. INTRODUCTION

Soil preparation method described in 'A *Jatropha* cultivation guide' by Chhattisgarh Biofuel Development Authority in CG India' for the maximum growth and productivity of the common bio-diesel plant *Jatropha curcas* L.[1] Also University of Florida Extension Publication and Miller *et. al.* explained to increase the soil fertility on their locations [2]. It is generally suggested that the common bio - diesel crop *Jatropha curcas* L is seen growing in any type of soil ,even in desert soil [3], So that *Jatropha species* is planted millions in number, the survival rate is very less, approximately 25 % in C.G. India . This is due to a myth that *Jatropha species* grow in any type of soil. The objective is to prove the effect of soil fertility on the growth and productivity of soil by a this comparative study between *Jatropha* plant grown in fertile soil of college botanical garden and *Jatropha* plant grown on disturbed soil of college campus , polluted by campus wastages.

Jatropha curcas L. is a perennial poisonous shrub (normally up to 5 m high belonging to the Euphorbiaceae or spurge family. *Jatropha curcas* L is a genus of the family Euphorbiaceae. The name is derived from (Greek *Jatros* = physician and *trophe* = nutrition), hence the common name is Barbados nut or Physic nut. It is used as a living fence to protect gardens and fields from animals. *Jatropha* is native to Central America and has become naturalized in many tropical and subtropical areas, including India, Africa, and North America.. It is resistant to a high degree of aridity (it can be planted even in the desert).The mature small trees bear separate male and female flowers, and do not grow very tall. As with many members of the family Euphorbiaceae, *Jatropha* contains compounds that are highly toxic. It is an uncultivated non-food wild-species. But, currently, the oil from *Jatropha curcas* seeds is used for making bio-diesel fuel in all over the world . *Jatropha* – oil is being promoted as an easily grown bio-fuel crop in throughout India and *Jatropha* is suggested an ideal plant for bio-fuel and *Jatropha* promotion countries are USA , Brazil, Benin , China , Ethiopia, Engaruka, Ghana, Guinea, Madagascar, Mali ,Mozambique Namibia . Senegal South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe etc.[4]

Vincent Nerée , a consultant in renewable energies, is of the view that Bio-diesel productions on a small scale allow individuals to cut their energy costs in Spain , He encourages the people to produce their own bio-diesel by recycling vegetable and animal fats, originating from industrial food production facilities and restaurants [5]

II. MORPHOLOGICAL FEATURE OF JATROPHA CURCAS L :

- **Roots:** Roots are branched taproot system. Their ashes are used as a salt substitute. HCN and Rotenone are present.
- **Bark:** Bark of *Jatropha curcas* is quite yellow –brownish, Used as a fish poison.
- **Stem:** Stem is sympodial branched system .It has not much hard wood being not so strong thus it has not timber or stick uses.
- **Leaves:** The leaves are alternate, seldom opposite, even looking like circular phyllotaxy with stipules . Stipules are reduced to hairs Leaves are simple, long- petiole and palm shaped large green to pale-green leaves are found.
- **Flowers:** The radically symmetrical flowers are unisexual, with the male and the female flowers usually occurring on the same plant. They can be monoecious or dioeciously. The stamens (the male organs) can number from 1 to 10 (or even more). The female flowers are hypogynous, that is, with a superior ovary. More female flowers yield more seeds
- **Fruit:** fruit is usually a schizocarp, A typical schizocarp is the regma, a capsular fruit with three cells, each of which splits open at maturity into separate parts and then breaks away explosively, scattering the large seeds. fruits are produced in winter, or there may be several crops during the year if soil moisture is good and temperatures are sufficiently high.

- Seeds: the seeds are mature when the capsule changes from green to yellow. The seeds contain 27-40% oil (average: 34.4%) that can be processed to produce a high-quality bio-diesel fuel, usable in a standard diesel engine [6]

Estimates of *Jatropha* seed yield vary widely, due to a lack of research data, the genetic diversity of the crop, the range of environments in which it is grown, and *Jatropha*'s perennial life cycle. Seed yields under cultivation can range from 1,500 to 2,000 kilograms per hectare, corresponding to extractable oil yields of 540 to 680 liter per hectare[7]

Time Magazine recently cited the potential for as much as 1,600 gallons of diesel fuel per acre per year [8]. *Jatropha* can also be intercropped with other cash crops such as coffee, sugar, fruits and vegetables. [9]

Characteristic of many members of the family Euphorbiaceae, *Jatropha curcas* contain several toxic compounds, including pectin, saponin, carcinogenic phenol, and a trypsin inhibitor. Despite this, the seeds are occasionally eaten. after roasting, which reduces some of the toxicity. Its sap is a skin irritant, and ingesting as few as three untreated seeds can be fatal to humans. In 2005 Western Australia banned *Jatropha curcas* as invasive and highly toxic to people and animals. [10]

As Bio-diesel projects are running in all states, Chhattisgarh has decided to plant 160 million saplings of *Jatropha* in all its 16 districts during 2006 with the aim of becoming a bio-fuel self-reliant state by 2015. Chhattisgarh plans to earn Rs.40 billion annually by selling seeds after 2010. The central government has provided Rs.135 million to Chhattisgarh this year for developing *Jatropha* nursery facilities. [11]

III MATERIAL AND METHOD

At first, tillage the soil of college's botanical garden is done then 10 pits of the size 0.3 x 0.3 m² at the distance of 2.0 m x 2.0 m are dig. Each Pit is filled with 0.12 kg super phosphate, 0.016 kg potash, and 2.5 Kg cow dung manure and these filled materials are properly mixed with the pit-soil with little more digging.

Tillage and digging of 10 pits are done also of disturbed soil of college campus ground, polluted by campus wastages, but the application of the manure and fertilizers is avoided .

Drainage system is maintained properly in the garden and campus, both. The seeds of *Jatropha curcas L* collected from same mother plant from Ambikapur forest. Seed of same size and weight *i.e.* 6.25g. is shown in each pit of garden and campus in the month of July at 37°C atm. temp. The selection of showing pits is kept such a way so that , irrigation , protection ,light and precipitation fall might be maintained same. Only the quality of soil would be different for both cultivars.

The comparative study of growth - length of seedling and (height) of the plant are noted each month on the same date by auxanometer, up to one year ,then after each year their morphology and physiology *i.e.* flowers basal area , herbage - cover of plant and number of branches per plant ,flowering time ,seed weight, and oil content is comparatively noted .The same weighted seeds - *i. e.* 10.00 Kg. of both , cultivars separately are sent to oil grinding - mill compare the oil content .

IV. RESULT AND DISCUSSION:

Productivity is in proportional to the soil fertility. The growth rate and production of seed are resulted higher in comparison to the disturbed soil .

Table 1. Comparative annual growth of *Jatropha* seedling and plant shown on 15 July2020 at 38°C temp. grown in fertile soil of garden and polluted soil of campus.

| Sr. NO. | Dates | Average Temp. | Length of stem in fertile soil (in cm.) | Length of stem in polluted soil(in cm.) |
|---------|-------------|---------------|--|--|
| 1 | 15 Aug.'05 | 40°C | 6.9 | 6.8 |
| 2 | 15 Sept.'05 | 38°C | 9.8 | 8.2 |
| 3 | 15 Oct. '05 | 35°C | 17.6 | 15.4 |
| 4 | 15 Nov.'05 | 27°C | 24.7 | 21.8 |
| 5 | 15 Dec.'05 | 18°C | 30.0 | 27.2 |
| 6 | 15 Jan.'06 | 14°C | 36.2 | 34.0 |
| 7 | 15 Feb.'06 | 19°C | 39.8 | 35.8 |
| 8 | 15 Mar.'06 | 26°C | 42.5 | 38.6 |
| 9 | 15Apr.'06 | 32°C | 58.6 | 46.9 |
| 10 | 15 May'06 | 39°C | 69.4 | 52.4 |
| 11 | 15 June'06 | 42°C | 75.8 | 65.8 |
| 12 | 15 June'06 | 41°C | 82.0 | 72,5 |

Table 2. Comparative observations (up to 26 Dec.2009) of growth and yielding of *Jatropha curcas* grown in fertile soil of garden and polluted soil of campus .

| Sr.NO. | Plant's Feature | In fertile soil | In Sterile soil |
|--------|--|-------------------|-------------------|
| 1 | Height | 4.8m. | 4.1m. |
| 2 | Herbage cover | 1.6m ² | 1.3m ² |
| 3 | Basal Area | 0.0785m | 0.0642m |
| 4 | Number of Branching | 12 | 9 |
| 5 | First flowering after showing | 2years 6monthths | 2years 4months |
| 6 | Average seed Weight /Y _r /plant | 3.62Kg | 3.24Kg |

Table 1 represents a comparative annual growth of *Jatropha* seedling and plant shown on 15 July 2005 at 41^oC temperature grown in fertile soil of garden and polluted soil of campus .There is a significant difference in their growth rate. The length of seedling increases rapidly then the length (height) of the plant and secondly the growth rate of the juvenile plant is higher than the older plants . Results also indicate that in the low temp. of winter season, the plant growth rate decreases . In the winter season, between December and January growth of *Jatropha curcas* juvenile plant, in the fertile soil is 6.2 cm. *i. e.* (36.2 cm – 30.0 cm) ,while in autumn season, in between month of March and April , it is 16.1cm, while in disturbed soil it is 6.8 cm and 8.3 respectively. It also indicate that plants on disturbed land have more resistance to the low temperature.

Table 2 represents comparative observations (up to 26 Dec.2009) of growth and yielding of *Jatropha curcas* grown in fertile soil of garden and polluted soil of campus .The difference in height, after 4 years of seed germination is 0.7m . Herbage cover is the area covered by the branches and leaves by a plant is found 1.6m² and 1.3m² respectively . Basal area of a plant is area covered by the stem at thr earth surface . Herbage cover and basal area are calculate by $A = \pi r^2$. Where A is Basal area / Herbage cover And r = radius *i. e.* half diameter of stem for basal area and total occupied place by plants leafy portion for herbage cover .

There is a quite difference in also in other morphological and physiological properties of the plants cultivated in fertile soil and polluted soil as represented in table 2 . The production of seed is main yield of *Jatropha*. Which is 3.62 Kg per plant per year in fertile soil while it is 3.24 Kg Kg per plant per year in polluted soil. Dry and disturb soil flowering happens earlier but productivity decrease in sterile soil. .

The plantation of *Jatropha specioses* is done in C.G. *i.e.* thousands plants per year per district . But only approximately fifty percent plants grow up to seed production age. This is due to the lack of botanical study *i.e* mainly ecological topography *e.g.* soil - pH ,and chemical composition of soil, physiological water stress, and other environ mental factors affecting it's growth and productivity. This Botanical study of *Jatropha specioses* will increase the survival rate of *Jatropha specioses* as well as the increase of the productivity.[12-18]

Fig 1 represents the morphological variations between both cultivars and fig 2 represents a significant difference in their herbage cover , while fig 3 presents a mature plant and mature fruits with seeds.

Conclusion

There is a significant effect of soil fertility on growth and quantity seeds production. But the oil content per unit weight of seed has not any difference. This indicates that total oil productivity may be increased by increasing fertility of soil. Since seed quantity is in proportion of oil production. So that it is recommended that the *Jatropha curcas* should be cultivated with a consideration of soil fertility for better production.

Fig-1 (a) *Jatropha* in Garden(b) *Jatropha* in Campus



Fig . 2 Plant of garden on fertile soil

b. Plant of camus on disterbed soil



Fig-3 (a) *Jatropha curcas* Plant

(b) *Jatropha curcas* seeds

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