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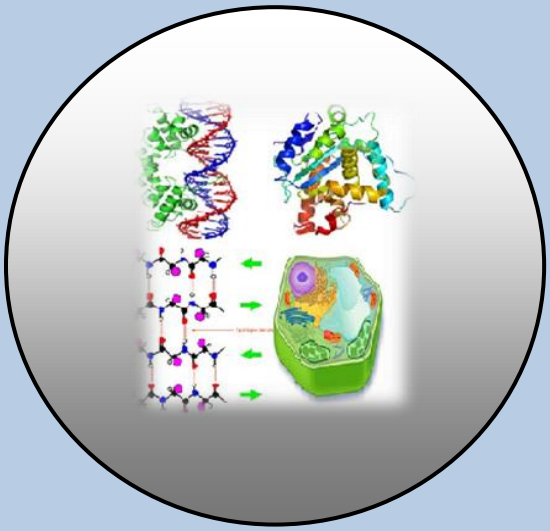

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RESEARCH PAPER

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Colchicine Induced Mutation Studies in *Jatropha curcas* L.

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ABSTRACT

In order to improve a petro crop through induced mutagenesis, seeds of Jatropha curcas have been treated (soaked) with different doses of colchicine and sown in randomized block designed beds along with control. Data were recorded on different parameters like germination; plant height leaves size, branch number, plant height etc. on definite intervals. Delay in germination, reduction and stimulation in plant height, branch and leaf number and different type of morphological abnormalities were observed after colchicine treatment. The effect of colchicine as a mutagen on initial development and growth pattern of Jatropha curcas is discussed in this research paper.
Keywords: Jatropha curcas, Colchicine, Mutant and Variability.

INTRODUCTION

The issue of looming energy crisis around the world has prompted researchers to pay keen attention to do research on alternative energy sources (Peaptung *et al*. 2009). A number of options for alternative liquid fuel production have been considered in many countries. Some are based on processing of fossil fuel such as coal, shale and fossil reserves although other are based on biomass, a renewable source of fuel. The potential production of ethanol and methanol from crop and crop residue has been evaluated (Stewart *et al*. 1981). The oil seed option could compliment alcohol fuel alternative, in that the seed oil are more suited for diesel than for petrol engine. In view of the uncertainties in the availability and price of liquid fuel from petroleum, it would appear prudent to carry out research and development on seed oil as alternative fuel for petroleum. Its need of nation to carry out research and development of seed oil as alternative fuel for diesel engine in order that their production and use could be rapidly implemented as per the need arises.

Jatropha curcas (Family- Euphorbiaceae) oil known as "curcas oil" has been reported as an efficient substitute fuel for diesel engine. The engine performance and fuel consumption

compared favorably with running the engine on normal diesel engine oil. It has been observed at the time of exhaust gas test that the engine when run with 'curcas oil' the value of carbon mono oxide and smoke was lower than the accepted value as per the standard specifications of the environmental board. There was no emission of SO_2exhaust as compared to 125 ppm in diesel engine exhaust.

Jatropha curcas L. [syn. *J. molucossa* (Watt 1890) is a native of tropical America has naturalized in India in several areas and is only cultivated as a hedge around cultivated fields in a semi-wild conditions. It was introduced in India by Portuguese as an oil yielding plant. It is commonly known as 'dravanti', 'jamalgota', 'jangaliarandi', 'ratanjota', 'baghbherenda', 'kattamanakku', and 'kacha' etc. in different states and languages of India. Different names has been popular in different countries like 'sabudam' in Thailand, 'thinbaukyeksu' in Burma, 'tuba' in Philippines, 'ma fongchau' in China, 'kadam' in Naipal 'pinheireo de purge' in Brazil, 'ricin de Amerique' in French and 'roppendaru' in Sri Lanka. It is unique plant adoptable to various kinds of soil conditions. It grows well on moderately sodic and saline degraded and eroded soil. The additional advantage of *Jatropha curcas* is that its oil is non-edible and capable of growing on wasteland so their production does not exert any pressure on agricultural lands of India. It can easily be propagated both either by seed germination or by stem cutting. It grows rapidly, adoptable to dry weather conditions and not browsed by goat and cattle. The seed contain about 42-48% of semi drying oil of pale yellow color with acrid taste and 70% moistures. As for as fatty acid content of curcas oil is concerned it contain 33 per cent saturated fatty acid dominated by Palmitic acid and 66 per cent unsaturated fatty acid mainly Oleic acid (Datta and Pandey 1996). Improvement of *Jatropha curcas* using conventional breeding technique is difficult due to its narrow genetic diversity (Basha and Sujatha 2007). The aim of this study is to investigate the effect of colchicine on inducing mutant in *Jatropha curcas*.

MATERIAL AND METHODS

Dry seeds of *Jatropha curcas* were soaked for 8 hours in 0.25%, 0.50% and 1.00% aqueous solutions of colchicine. The control seeds were also kept immersed in distilled water for the same period. Following the treatment seeds were thoroughly washed in running water and sown in randomized blocked designed beds. Periodical data were recorded on various Parameters including germination (time and percentage), leaf size, growth (height), stem diameter, branch number, abnormal plants, plants with tricotyledonary leaves, stem diameter and other morphological characters.

RESULTS AND DISCUSSION

Seed germination in the present experiment has been defined as the sprouting of the seedling over soil level in the field. Seed germination after treatment with 0.25% colchicine was more than the control. Germination percentage was reduced in 0.50 and 1.00% colchicine treated population (Table 1). A maximum of 35.42% reduction (as % of control) was recorded after treatment 0.50% colchicine as wellas 12.50% increase in germination was observed in 0.25% colchicine treated population. Germination was delayed after treatment with colchicine and the delay was significant ($P<0.01$) after the treatment with 0.50 and 1.00%. The size of cotyledonary leaves increased after colchicine treatment.

The increase in size was significant (P<0.01 to P<0.001) in most of the cases. Reduction in seed germination in *Jatropha curcas* after treatment with colchicine has earlier been reported by Chiangmai *et al*. 2014.

Most of the plants in colchicine treated population showed various kind of abnormal growth and appeared as chimeras. The manifestation of abnormal plant growth, in general was irrespective of the mutagen applied. The seed being multi cellular in organization, its cell were composed of various affected and normal cells after treatment with colchicine and the resultant seedling showed different type of abnormal growth. Due to successful completion of affected and normal cells the first generation plants appeared as chimeras. In chimeric tissues mutated and normal cells are present intermingled which is bottle neck for induction of mutagenesis in plants (Datta and Chakrabarty 2009). Abnormalities were recorded from the very early stage of development of seedlings.

Table 1. Effect of colchicine on some parameters of *Jatropha curcas* in C_1 generation.

Parameters	0 (Control)	Colchicine (Concentration)		
		0.25%	0.50%	1.00%
Germination (%)	64.00	72.00	41.33	46.67
Germination time (days)	6.57 ±1.41	6.18 ±0.64	7.76** ±1.53	8.00** ±2.53
Length of cotyledonary leaves	5.72 ±0.18	6.36** ±0.09	6.41*** ±0.12	5.80 ±0.12
No. of tricotyledonous plants (% ± SE)	11.43 ± 5.38	0.00	4.00 ± 3.91	4.16 ± 4.07
15 days seedling height (cm ± SE)	9.05 ±0.30	9.00 ±0.25	9.45 ±0.22	8.73 ±0.36
1st month plant height (cm ± SE)	14.37 ±0.69	14.17 ±0.59	14.74 ±0.62	13.37 ±0.54
2nd month plant height (cm ± SE)	17.69 ±1.08	18.06 ±1.03	19.19 ±0.93	15.97 ±0.65
3rd month plant height (cm ± SE)	23.55 ±1.50	24.16 ±1.48	24.19 ±1.72	21.15 ±1.23
No. of Branches (average ± SE) after 6 months	11.76 ±0.78	9.85 ±0.87	10.69 ±1.07	9.70 ±0.89
Percent abnormal plant After 30 days After 60 days	10.63 ± 3.26 4.25 ± 2.94	35.55 ± 7.13 55.55 ± 6.76	17.86 ± 7.23 66.62 ± 8.33	17.86 ± 7.23 70.58 ± 7.85
Stem diameter (cm ± SE) After 6 months After 12 months	3.85 ± 0.11 5.23 ± 0.12	3.95 ± 0.13 5.11 ± 0.13	4.32*** ± 0.08 5.54* ± 0.10	4.00 ± 0.09 5.17 ± 0.12

*** = P <0.05** **** = P <0.01** ***** = P <0.001**

In general all the seed lings had two cotyledons which are apposition in position, however development of few tricotyledonary seedlings were also observed in control as well as treated populations. The maximum percentage of abnormal plants was recorded after treatment with 0.25% colchicine. At 60 days, the percentage of abnormal plants increased with increase in colchicine concentrations (Table-1). Physical mutagen induced abnormal plant growth has been reported by number of worker and this aspect has been reviewed by Gunckel and sparrow 1961. Abnormal plants are also present in control plants, Datta 1988has shown that radiation and colchicine induced chromosomal changes are not the cause of abnormal growth, but it is associated with non-heritable physiological disturbances of growth substance, induce by mutagens.

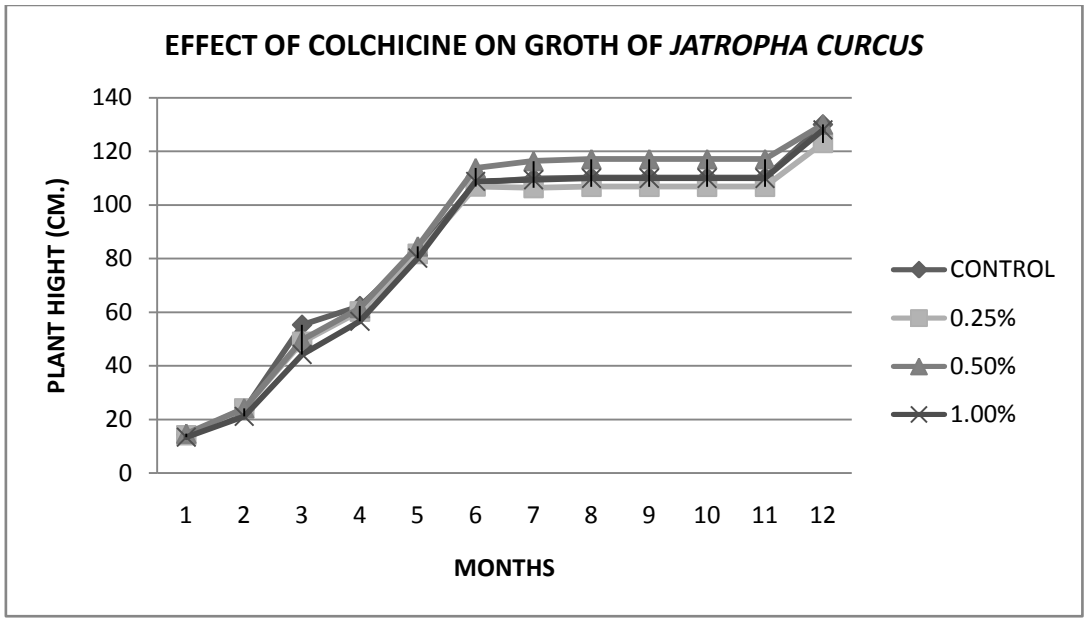

Figure 1.

During the course of one year study a clear picture was found on its growth rate. The growth rate was directly proportional to the age of plant since its sowing in the first week of April. The growth was steady was steady up to 180 days (November). There was no significant growth during the period of 180-330 days after which further growth of the plant started. It was interesting to note that leaves of Jatropha curcas shed off from Dec. to February during which the growth of plant remain stationary. The initiation of the new leaves and further growth of the plant start simultaneously from 3rd week of March. During the present experiment no significant difference in plant height was observed after colchicine treatment. Same type of result after treatment of *Jatropha curcas* with colchicine on plant height has reported by Chiangmai *et al*. 2014.Plant height was used as an indicator to predict the ploidy level in plant (Miller *et al*., 2012). Only the plant height of 0.50% colchicine treated population was more than the control (Fig-1). Stimulatory effect in branching pattern was observed after colchicine treatment up to 4 month of growth after that reduction in branch number was observed in colchicine treated population as compare to control (Fig-2). There was no significant difference in stem diameter was observed in 0.25% and 1.00% colchicine treated population, whereas it was significantly more in 0.50% treated plants (Fig-3).

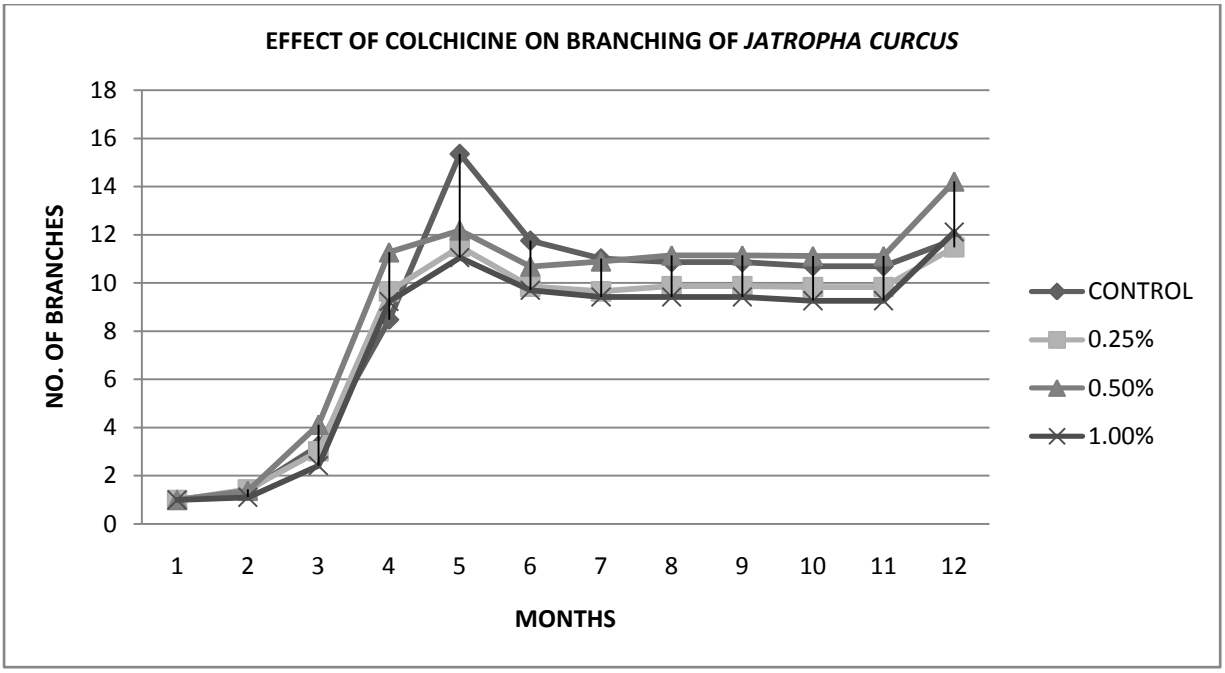

Figure 2.

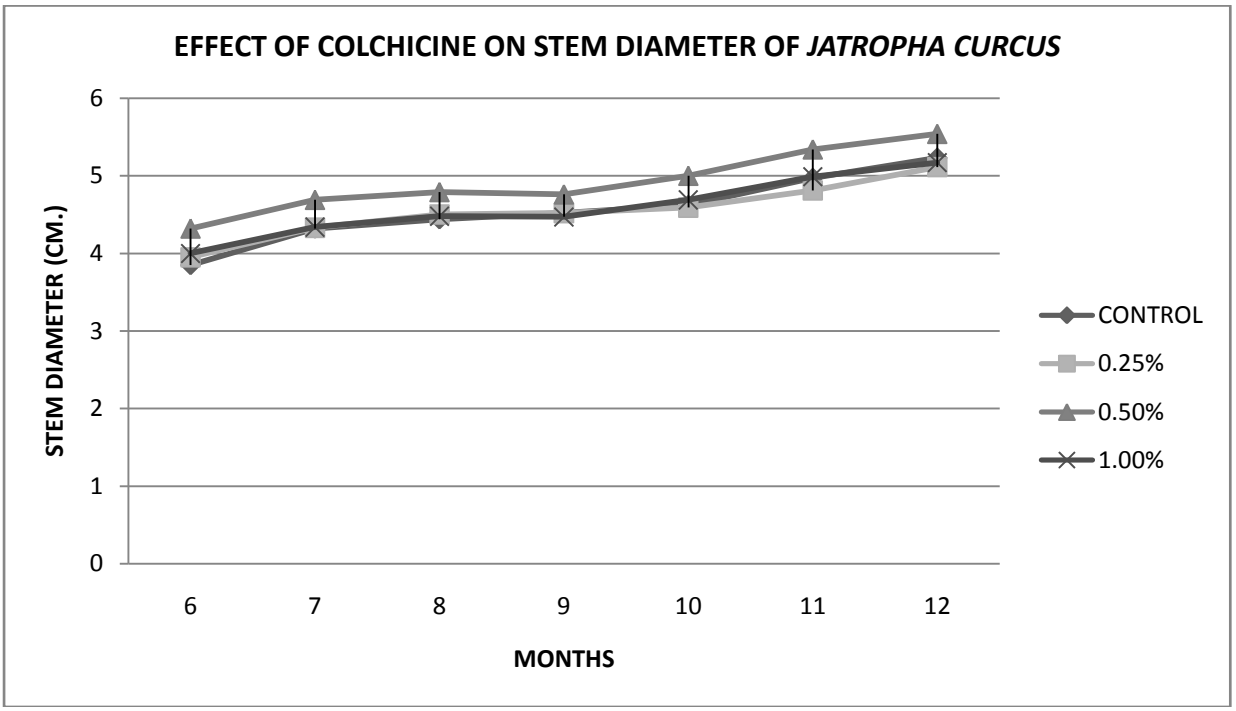

Figure 3.

CONCLUSION

It is evident from the present experiment that different biological characters that directly or indirectly contribute for increase in productivity of *Jatropha curcas* are sensitive to colchicine. It appears that with proper isolation, evolution, selection and improvement of *Jatropha curcas* a sustainable oil seed plantation can be made feasible for commercial exploitation.

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