CHAPTER - 7

SUMMARY AND CONCLUSION
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7.1 Summary.

The genus *Jatropha* L. is classified under the family *Euphorbiaceae* and is found to grow throughout the North Eastern regions of India. *Jatropha* species are known for their bio-fuel and ornamental values.

Plants included in the present study were *Jatropha curcas* L. and *Jatropha gossypifolia* L. These two species of *Jatropha* were collected from different geographical locations of the North Eastern Region of India studies on cytology, floral biology, seed morphometrics and oil content were undertaken in both the species.

The investigated species are ethno botanically well known for various kinds of uses such as ornamental, as boardered plants, as potential oil crops, as raw materials for industrial uses, as medicinal plants, used for dyes as well as insecticides and pesticides. Studies pertaining to cytology, floral biology, seed morphometrics and oil content in each species were undertaken. The findings are summarized as follows.

*Jatropha curcas* L. is a perennial plant growing on marginal soils. This species is widespread throughout arid and semiarid tropical regions of the world and has been used as a traditional folk medicine in many countries. *Jatropha curcas* L. is a source of several secondary metabolites of medicinal importance. The leaf, fruits, latex and bark contain glycosides, tannins, phytosterols, flavonoids and steroidal sapogenins that exhibit wide ranging medicinal properties. The plant products exhibit anti-bacterial and anti-fungal activities.

It was observed that *Jatropha curcas* L. grow better on dry red soil, mountainous coarse red soil and on the alluvial sandy soil than on the common mountainous red soil. Similarly, the *Jatropha gossypifolia* L. commonly found in disturbed soils of Assam. There was no significant difference in the oil content of the seeds sampled from trees growing on different soil conditions in both the species.
In both *Jatropha curcus* L. and *Jatropha gossypifolia* L. the chromosomes were grouped under the following categories based on their total lengths:

i) **Type A** = Total length of chromosome varying from 2.50-3.00 μm,
ii) **Type B** = Total length of chromosome varying from 2.00-2.49 μm,
iii) **Type C** = Total length of chromosome varying from 1.50-1.99 μm.
iv) **Type D** = Total length of chromosome varying from 1.00-1.49 μm.

Similarly on the basis of centromeric position, the chromosomes were classified as shown below:

a) **M** = Median sensu stricto, arm ratio 1.0-1.6 μm.
b) **m** = Median, arm ratio 1.7-2.9 μm.
c) **sm** = sub median, arm ratio 3.0-6.9 μm.
d) **st** = sub terminal, arm ratio 7.0 μm.
e) **t** = terminal, arm ratio 0.0 μm and
f) **T** = Terminal sensu strictu, arm ratio 0.0 μm.

Based on the above informations, the chromosomal data are summarized as follows. In *Jatropha curcus* L. the maximum length of the chromosomes was found to be 1.49 μm and the minimum was 1.40 μm. Therefore, Type A chromosomes with length above 2.49 μm and Type B with length from 2.00 μm to 2.49 μm were not found. Only the Type C and Type D were found (range being 1.40 μm to 1.94 μm). The different chromosomes were as follows.

\[ A_0 + B_0 + C_{16} + D_6 = 2n = 22. \]

Similarly in *Jatropha gossypifolia* L. the maximum chromosomes length was found to be 2.73 μm and the minimum as 1.67 μm. Therefore, Type D chromosomes with length below 1.00 μm were not found in *Jatropha gossypifolia* L. Type A, Type B and Type C were found (range being from 1.67 μm to 2.73 μm). The different chromosomes were as.

\[ A_2 + B_{13} + C_5 + D_0 = 2n = 20. \]

The cytological investigation revealed that the chromosomes of *Jatropha curcas* L. relatively small (1.59 μm) being in the range of 1.5μm to 1.94 μm and the volumes were ranged between 0.08 μm to 0.245 μm. The
karyotypic formula deduced as: $m_{20} + sm_{2} + st_{0} + t_{0} = 2n = 22$. No telocentric chromosome was found in *Jatropha curcus* L.

In *Jatropha gossypifolia* L. the chromosomes are of 1.67 µm to 2.73 µm in length and 2.15 µm in average and are relatively larger than those of *Jatropha curcus* L. The volume was ranged between 0.181 µm to 0.461 µm. The karyotypic formula deduced as: $m_{14} + sm_{6} + st_{0} + t_{0} = 2n = 20$. No telocentric chromosome was found in *Jatropha gossypifolia* L. also.

The study on floral biology reveals details flower structures and understanding of their function in the process of pollination. The findings of the study are as follows:

In *Jatropha curcus* L. the male/female flower ratio was 21.38±0.47:1; size of the male flowers ranged between 5–7 mm, length of the petioles ranged from 5–10 mm, Sepals 3–5 mm, petals 7–10 mm, filaments 3.8–4 mm and anther lobes 1.8–2 mm. Similarly the size of the female flowers ranged between 5–7 mm, petioles 6–9 mm, sepals 3.5–7 mm, petals 4–8 mm, style 1 mm, stigma 1 mm and ovary 2.9–3 mm. Pollen grains were of tetrahedrad tetrad, isopolar, radially symmetry, spheroidal in shape and monotreme in apperature. Size of the pollen grain was 48.25±3.24 µm. Pollen grain germinations were responded in 15% sucrose solution at 20°C temperature ($r=0.589826$) and in 35% sucrose solution at 40°C temperature ($r=0.654691$).

In *Jatropha gossypifolia* L. the male/female flower ratio was 20.44±0.15:1. The size of the male flowers ranged between 3–5 mm, length of the petioles ranged between 1.5–3 mm, Sepals 3.2–4.2 mm, petals 5–6 mm, filaments 1.6–2 mm and anther lobes 1–1.3 mm. Female flowers ranged between 5–6 mm, petioles 1–1.2 mm, sepals 2.5–3 mm, petals 4.6–5 mm, style 1 mm, stigma 0.98 mm–1 mm and ovary 2.8–3 mm. Pollen grains were of tetrahedrad tetrad, isopolar, radially symmetry, spheroidal in shape and monotreme in apperature. Size of the pollen grain was 63.27±7.25 µm. Pollen grain germinations were responded in 10% sucrose solution at 15°C temperature ($r=0.751761$) and in 35% sucrose solution at 40°C temperature ($r=0.82418$).
The seed morphometrics serve as taxonomical markers and also serve in deducing phylogenetic relationship. The studies on seed morphometrics reveal that in *Jatropha curcus* L. the seed colour was blackish. The weight of the seeds ranged between 0.69–0.89 gm (0.77±0.01). Similarly the length of the seeds varied between 15.85–19.01 mm (17.27±0.08), breadth as 9.39–11.18 mm (10.31±0.06) and thickness as 8.05–9.01 mm (8.46±0.03). In *Jatropha gossypifolia* L. the seed colour was brownish, seed weight ranged between 0.048–0.049 gm (0.05±0.00), length as 6.98–7.26 mm (6.91±0.99), breadth as 4.03–5.01 mm (4.39±0.63) and thickness as 3.12–3.71 mm (3.38±0.48).

*Jatropha curcus* L. contain 34.53% to 53.23% oil (with seed coat, mean = 43.41±1.04); 43.30% to 64.52% oil (without coat, mean = 54.58±1.09). In *Jatropha gossypifolia* L. the oil content was 26.98% to 40.55% (with seed coat, mean = 34.08±0.68) and 26.93% to 45.18% oil (without coat, mean = 37.47±0.88). *Jatropha curcus* L. clearly showed more oil content as compared to *Jatropha gossypifolia* L.

### 7.2 Conclusion.

The study on karyomorphology of *Jatropha* spp. showed genetic diversity provides the proper guidelines for the collection, conservation and characterization, thereby intensifying the possibility of widening genetic base of their germplasm through hybridization among different genotypes, as they are crossable species.

Flowering of both the species were not sensitive to day length.

The present study revealed the considerable genetic variability in *Jatropha* spp. in respect to seed traits. Therefore, it is advisable that these seed traits should be used for collection of bulk quantity of seed to better productivity.
Biofuel is a potential alternative for non-renewable fuels. It is gaining importance in recent times in developing countries because of its bio-based, eco-friendly, biodegradable, non-toxic, sustainable and renewable fuel source.

Biofuel cropping systems provide income to farmers who are around to degraded land and are facing economic hardship. Farmers of good agricultural land can also benefit by planting *Jatropha* along the boundary of fields. *Jatropha* is not a large plant that can obstruct air or sun to the main crop. In addition, being non-edible, it will protect the main crop from the stray animals.

*Jatropha* requires minimal quantity of water and fertilizer. They are highly suitable, in semi dry land. About 65 million hectares of total wasteland is available including 14 million hectares of waste land in forest, under Management as far the Planning Commission Report of India (2004). There is potential to cover this wasteland with the *Jatropha*, a bio-fuel species. Bio-sources, including *Jatropha* spp. are expected to be potential options for the production of fuel in order to ensure a continuity of fuel supply to our transportation and industrial sectors.

From the present investigation it may be concluded that the *Jatropha curcus* L. has unlimited uses and potential as compared to *Jatropha gossypifolia* L. But, the profitability of *Jatropha* cultivation is still in question. Because, in absence of availability of authentic data and judging by observation and enquiries it was clear that cultivation of *Jatropha* alone is not in a very attractive proposition. Accounting byproducts in multidirectional aspect and inter-cultivation is the positive answer for the cultivation in large scale.