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Cytomorphological and biochemical characterization of nine species of *Corchorus* aiding to interspecific hybridization and induced mutagenesis in *C. olitorius* L. (Family: Tiliaceae).

The species of the genus *Corchorus* (Family: Tiliaceae) are annual plants and are found distributed in warm regions throughout the world (Kundu, 1951; Purseglove, 1968). 'Index Kewensis' includes more than 170 species (Mahapatra and Saha, 2008) in *Corchorus* and based on species concentration East and South Africa were considered to be the centre of diversity and place of origin (Kundu, 1951; Singh, 1976; Edmonds, 1990), though both the cultivated species of jute (*C. capsularis* and *C. olitorius*) are distributed throughout India. The genus *Corchorus* is extremely variable but all species are highly fibrous. Mahapatra *et al.* (1998) reported 10 species (2 cultivated and 8 wild) from India namely *C. capsularis* L. and *C. olitorius* L., *C. aestuans* L., *C. depressus* Stooks L., *C. fascicularis* Lam., *C. pseudoolitorius* I. and Z., *C. tridens* L., *C. trilocularis* L., *C. urticaefolius* W. and A. and *C. velutinus* Her.

*C. capsularis* (white jute) and *C. olitorius* (tossa jute) yields fibre of commerce from bark of the stem (phloem fibre) and are widely cultivated in India, Bangladesh, Nepal, China, Indonesia, Thailand, Myanmar and in South American countries. The major jute growing states in India are West Bengal, Bihar, Assam, Uttar Pradesh, Meghalaya and Tripura. The fibre obtained from the cultivated species is retted in water and termed as jute. Jute was previously named as 'pat' (Wallace, 1909). The jute fibre is used mostly for making gunny bags and packaging material for agricultural and other industrial products. India contributes about 40 per cent of the world production of jute fibre earning annually 1200 crore rupees approximately as foreign exchange by exporting different jute products (Karmakar *et al.*, 2008). The cultivation of jute improves the soil fertility status by shedding the leaves in the field. The crop also suits well in crop rotation and has high socio-economic (about 2.5 lakh people are employed in the jute industry and 25 lakhs people are engaged in jute based ancillary sector – Karmakar *et al.*, 2008) significance in India.
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*C. capsularis* is considered to be native to South China from where it migrated to India and Bangladesh (Purseglove, 1968). However, Kundu (1951) and Mahapatra *et al.* (1998) believes that this species is not an immigrant to India but had originated in Indo-Myanmar region including South China. In contrast, *C. olitorius* is proposed to be native to Sri Lanka, India and Kenya and it is now agreed that the species originated in Africa along with other wild species and migrated to India and China via Egypt and Syria (Kundu, 1951; Edmonds, 1990; Mahapatra *et al.*, 1998).

The wild species of jute though poor fibre yielder, are important genetic resources for abiotic stress tolerance (*C. trilocularis*), disease resistance (*C. urticaefolius* - showed resistance reaction to all diseases but anthracnose- Palve *et al.*, 2004; *C. pseudoolitorius* and *C. pseudocapsularis* – resistant to fungal diseases) and fine fibre quality (*C. tridens*, *C. trilocularis* and *C. aestivalis*) parameters (Mahapatra and Saha, 2008). *C. trilocularis* is the only tolerant genotype to water inundation (Mahapatra and Saha, 2008).

*Corchorus* germplasms occurs in diverse ecological conditions and habitats like river banks, dry river bed, low altitude valley within mountain folds, hill cliffs, forest floors with open canopy, marshy lands road side fallow, ditches, cultivable as well as homestead lands. In India, the most dominating species in occurrence is *C. aestivalis* followed by *C. olitorius*, *C. capsularis*, *C. tridens*, *C. trilocularis* and *C. fascicularis* (Mahapatra and Saha, 2008). *C. capsularis* is frequently distributed in Northern parts of India and gradually become scarce towards West. In contrast, *C. olitorius* is more frequent in Western and Northwestern India. *C. tridens* and *C. trilocularis* are restricted to Central, Western and Southern part of the country whereas *C. fascicularis* is restricted in Western and peninsular India. *C. urticaefolius* is also restricted in Tamil Nadu of Southern India while *C. pseudoolitorius* is distributed in Western boundary of the country.
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Collection of trait specific germplasms (wild species of jute) is a compulsion as these wild species may be exploited for efficient breeding endeavor with cultivated members for crop improvement. The germplasms are mostly evaluated for potential donor for desirable trait(s). For the purpose, information on morphological, cytological, cytogenetical and biochemical aspects may provide certain knowledge base to formulate breeding strategy for interspecific hybridization.

Induced mutants enriches gene pool through creation of genetic variability within a short period of time. Mutant induced may be used directly, and if possible indirectly into cross breeding programmes for crop improvement. Various aspects on both basic and applied mutagenesis in jute are reported (Kundu *et al.*, 1961; Sharma and Ghosh, 1961; Basu, 1965; Rakshit, 1967; Singh *et al.* , 1973; Thakare *et al.*, 1973; Bose and Banerjee, 1976; Shaikh and Maih, 1985; Chattopadhyay *et al.*, 1999). Desirable mutants in *C. olitorius* (TJ 40, JRO 3690, KOM 62, Bidhan, Rupali Tossa pat) and *C. capsularis* (JRC 7447, KC1, Bidhan pat 1, 2 and 3) are reported (Hazra and Karmakar, 2008). Mutation in jute should related to the improvement in fibre yield and fibre fineness and in increase in yield contributing traits.

Induction of desirable ‘plant type’ mutation in jute exploring the pre-existing superior ones should be a continuous process so that demand in jute trade always exists in National and International markets. Gustafsson (1947) advocated that mutation approach was superior to other methods of crop improvement; while Brock (1977) was of the opinion that induced mutation may be exploited for manipulation of genetic variations. Swaminathan (1972) suggested that induced mutation provides an ample opportunity for reconstruction of plant ideotypes.

Although induced mutation is of great relevance in modern plant breeding for the development of improved plant types (Kharkwal, 2000) mostly drastic changes of the phenotype, brought about by mutational events among the genes (Scossiroli, 1965) due to random actions of the mutagen(s) employed, often causes low productivity and does
not possess any practical value. Mutagenic responsiveness of the genotype concerned is therefore considered to be a vital event for success of mutation breeding experiment (Hagberg et al., 1963). Thus, it is of utmost importance to gain basic information regarding mutagenic sensitivity, efficiency and effectiveness of the mutagens employed to monitor successful mutagenesis and to raise viable macromutants of interest.

Chemical mutagens played significant role for the artificial induction of mutation (Konzak et al., 1965) due to their mutagenic potentiality, relative ease of application and low cost and among them EMS (ethyl methane sulfonate), a mono-functional alkylating agent is considered to be most effective (Auerbach, 1958; Gustafsson, 1963; Rayan and Heslot, 1963; Ehrenberg et al., 1966; Loveless, 1966; Sato and Gaul, 1967; Konzak et al., 1977). Apart from the use of chemical mutagens for induction of mutation, physical mutagens are also widely used in plant breeding for crop improvement (Nilan et al., 1965). Amongst the radiations, gamma-rays are potent source of cancer therapy (Hodes et al., 1961; Johnson et al., 1961) and are widely used in plants for induction of mutation for crop improvement (Raj et al., 1972; Rao, 1977; Poddar et al., 1998; Chowdhury and Datta, 2008).

Present investigation deals with morphological (including analysis of seed and seed-coat structures following SEM analysis), anatomical (stem anatomy), palynological, physiological (stomatal characteristics), cytological (mitotic and meiotic chromosome configurations were assessed) and biochemical (protein polymorphism following SDS-PAGE) characterization of nine jute species (cultivated: *C. capsularis* and *C. olitorius*; wild: *C. aestuans*, *C. fascicularis*, *C. pseudocapsularis*, *C. pseudoolitorius*, *C. tridens*, *C. trilocularis*, and *C. urticaefolius*) with an objective to ascertain interrelationship between/ among the germplasms which may be successfully exploited for interspecific hybridization and crop improvement. Further, the methodology of induced mutagenesis following gamma irradiations and EMS treatments was attempted in *C. olitorius* var. JRO 524 (JRO 524 is a high seed yield variety – Ghosh et al., 2008) to create genetic variations and to raise desirable ‘plant type’ mutation which may enrich jute trade in
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future. Induced mutagenesis deals with the following aspects: 1, mutagenic sensitivity of the genotype and assessment of mutagenic efficiency and effectiveness of the mutagens employed. 2, screening of ‘plant type’ mutations from M$_2$ population. 3, cytogenetic analysis of the morphological mutants. 4, study on the inheritance pattern of the mutant traits from M$_3$ population. 5, assessment of fibre yield and other yield and yield related traits of the mutants in relation to control. 6, analysis of post retting data in mutants and control. 7, biochemical analysis of mutants in comparison to control and 8, evaluation of protein polymorphism in the plant types following SDS-PAGE.

Crossing experiment was designed using the wild species *C. trilocularis* (possessing fine fibre trait and only tolerant species to water inundation – Mahapatra and Saha, 2008) as female parent and *C. capsularis* as male parent with the view to conserve the wild germplasm and to create genetic diversity. F$_1$ plants raised from crossings were cytomorphologically assessed. F$_2$ and F$_3$ plants were also evaluated cytomorphologically to assess stability of F$_1$ cross derivatives. One amphidiploid was raised from F$_1$ plants following colchicine treatments, and cytomorphological behaviour of the marked plant was ascertained.