INTRODUCTION
Introduction

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*. 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). The cultivated species of jute (*C. capsularis* and *C. olitorius*) are distributed throughout India. The genus *Corchorus* is extremely variable and all species are fibrous. Mahapatra et al. (1998) reported 10 species (2 cultivated and 8 wild) from India namely, *C. capsularis* L., *C. olitorius* L., *C. aestuans* L., *C. depressus* Stooks L., *C. fascicularis* Lamk., *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) yield fiber of commerce from bark of the stem (phloem fiber) and are widely cultivated in India, Bangladesh, Nepal, China, Indonesia, Thailand, Myanmar and in South American countries (Mahapatra and Saha 2008). The major jute growing states in India are West Bengal, Bihar, Assam, Uttar Pradesh, Meghalaya and Tripura. The fiber obtained from the cultivated species is retted in water and termed as jute. Jute was previously named as ‘pat’ (Wallace 1909). The jute fiber is used mostly for making gunny bags and packaging material for agricultural and other industrial products. India contributes about 40% of the world production of jute fiber earning annually 1200 crores 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 (on an average, 15 tonnes of green jute leaves per hectare: http://www.jute.org/planting.htm) in the field (International Jute Study Group - http://www.jute.org/ecology.htm). The crop also suits well in crop rotation and has high socio-economic (about 2.5 lakhs 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. Fresh leaves of *C. olitorius* are reported to possess rich source of vitamin A and C. The small amount of protein present is rich in methionine (Ogunkanmi et al. 2010). The leaves are used in the treatment of chronic cystitis, gonorrhoea, dysuria and toothache (Hillocks 1998). The seeds are used for fever and as a purgative and also possess broad antibacterial properties (Pal et al. 2006).
**Introduction**

*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, even though yielding poor amounts of fiber, are important genetic resources. *C. trilocularis* is the only water tolerant genotype (Mahapatra and Saha 2008). Both *C. pseudocapsularis* and *C. pseudooolitorius* are resistant to most of the fungal diseases (Palve *et al.* 2004); while, *C. aestuans, C. tridens* and *C. trilocularis* possess fine fiber quality (Mahapatra and Saha 2008). *C. urticaefolius* showed resistance reaction to all diseases but anthracnose (Palve *et al.* 2004).

*Corchorus* germplasms occurs in diverse ecological conditions and habitats like river bank, dry river bed, low altitude valley within mountain folds, hill cliff, forest floor with open canopy, marshy land, road side fallow, ditches, cultivable as well as homestead lands. In India, the most dominating species in occurrence is *C. aestuans* 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 North-Western 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. pseudooolitorius* is distributed in Western boundary of the country.

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. For successful hybridization experiment it is of paramount significance to ascertain genetic relatedness as well as distinctiveness between/ among *Corchorus* species. For the purpose, information on morphological, palynological, cytogenetical and biochemical including molecular aspects of *Corchorus*
spp. may provide certain knowledge base to formulate efficient breeding strategies for interspecific hybridization. Interspecific hybridization between *C. aestuans* and *C. capsularis* (Islam and Sattar 1961), *C. trilocularis* and *C. capsularis* (Faruqui 1962; Arangzeb and Khatun 1980; Khatun 2007), *C. aestuans* and *C. olitorius* (Haque and Islam 1970), *C. sidoides* and *C. siliquosus* (Datta and Sen 1961), *C. olitorius* and *C. depressus* (Islam et al. 1973) among others were performed to incorporate desirable qualitative trait(s) from wild to cultivated members as well as to enhance genetic diversity in *Corchorus*. However, none of the hybrid has been reported to be of practical significance due to hybrid breakdown. A hybrid ‘Tri Cap’ (*C. trilocularis* donating fine fiber trait to *C. capsularis*) has been reported from Bangladesh (Khatun 2007) to be of practical significance but detail information is rather lacking.

Information on genetic diversity within and among closely related crop varieties/species/germplasms is essential for crop improvement and to meet the diverse goals like producing cultivars with increased yield (Joshi and Dhawan 1986), wider adaptability, desirable quality, pest and disease resistance among others (Nevo et al. 1982). Analysis on jute genetic diversity and relatedness at its molecular level has been reported by Hossain et al. (2002) and Qi et al. (2003a) using RAPD; Basu et al. (2004) using SSR and Roy et al. (2006) using STMS, ISSR and RAPD markers. Hossain et al. (2003) characterize cold-tolerant and cold sensitive jute germplasms and Qi et al. (2003b) classified wild jute species using Inter Simple Sequence Repeat (ISSR) marker. Akter et al. (2008) and Mir et al. (2008a) reported the utility of studying genetic variability for different traits in jute genotypes using jute specific SSR markers.

Mutation offer ample scope of genetic variations and widen the gene pool in a quick span of time. Desirable variation(s) induced through mutagenesis relating to crop improvement are screened which altered the ideotype in jute (*C. capsularis* and *C. olitorius*). Induced ‘plant type’ mutation has been 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 Miah 1985; Chattopadhyay et al. 1999; Hazra and Karmakar 2008; Maity and Datta 2009a) in both *C. capsularis* and *C. olitorius*. Raising ‘plant type’ mutants is significant resource for crop improvement.

Present investigation deals with morphological, palynological (including pollen morphology using acetolysis technique and SEM analysis), cytological (comprehensive
meiotic chromosome behaviour including cytomixis which has been prevalent in some species), biochemical (protein polymorphism following SDS-PAGE - sodium dodecyl sulphate-polyacrylamide gel electrophoresis) and molecular (RAPD – Random Amplification of Polymorphic DNA and ISSR – Inter Simple Sequence Repeat markers) characterization of eight Corchorus (Family: Tiliaceae) species (cultivated: C. capsularis and C. olitorius; wild: C. aestuans, C. fascicularis, C. pseudocapsularis, C. pseudoolitorius, C. tridens and C. trilocularis) with an objective to ascertain relatedness between/among the germplasms, which may be exploited for efficient breeding and crop improvement. Further, a hybrid line raised between C. trilocularis (as stigma parent) and C. capsularis (as pollen parent) has been assessed morphologically, cytologically (meiotic chromosome behavior) and palynologically (pollen morphology, fertility and viability) for its stability and viability in advance (F$_4$ to F$_6$) generations. Selfed seeds of a single hybrid plant was forwarded in each generation to avoid genetic contamination and F$_6$ harvested seeds were used for molecular analysis (RAPD markers are used) to authenticate the raised hybrid with an objective to raise a stable and true hybrid line in jute. Moreover, true breeding macromutants namely, ‘lax branching’, ‘pigmented stem’ and ‘viridis’ of C. olitorius raised and assessed upto M$_4$ generation by Maity and Datta (2009a) are evaluated in advance generations (M$_5$ to M$_7$) upon considering germinability, quantitative traits, meiotic attributes, pollen morphology (using acetylolic technique and SEM analysis), pollen viability (using different stain tests and fluorescent dyes – DAPI; 4’,6-diamidino-2-phenylindole and FDA; fluorescein diacetate), pollen fertility (acetocarmine staining), seed viability, quantitative and qualitative (SDS-PAGE) estimation of seed protein and molecular (RAPD and ISSR markers) aspects in comparison to control to ascertain true breeding nature of the mutants as well as stability. The objective is to recommend the ‘plant types’ as ‘new germplasm resources’ in the species.