INTRODUCTION

Jute is an important fibre of commerce and, next to cotton, is the cheapest and most important among the textile fibres. It is used extensively in the manufacture of different types of packaging materials for various agricultural and industrial products. By exporting both raw and manufactured jute, India earns a very significant amount of foreign exchange every year. This is the imperative behind the concerted efforts being made by the Government of India for raising the acreage under jute and for increasing the production of jute fibre.

Jute fibre is obtained from the bark of the two cultivated species of the genus *Corchorus* viz. *capsularis* and *olitorius* belonging to the family Tiliaceae. Jute is called by different names in different jute growing States of India. In West Bengal, it is called 'pat'; in Orissa, 'jhot', 'jhout' or 'jhuta'; in Assam 'pata' or 'marapata'; and in Bihar 'patua'. In English, jute has once been known as 'Jew's-mallow', which is derived from the old name *Glyce judicum* (Boyle, 1855).

The most agreed view is that there are about 40 species under the genus *Corchorus*, which are distributed throughout the tropics. The maximum diversity of the species is found in the tropical regions of Africa, America, Australia, China, Taiwan, India, Ceylon,
Japan, Java etc. (Kundu, 1951). The largest number of the species under this genus is, however, found in Africa. Only eight species are reported to have been found in India. These include both the cultivated species viz. *C. capsularis* L. and *C. olitorius* L.

As regards the centre of origin of the above two cultivated species, both having same chromosome numbers (n=7), views have differed. Kundu (1951), discussing all the aspects of the origin of jute, concluded that the primary centre of origin of *C. olitorius* L. is Africa and that India or the Indo-Burma region may be the secondary centre. *C. capsularis* L. is not found in Africa or in Australia. Many early botanists considered *C. capsularis* L. to be of Chinese origin. Watt (1908) was of the opinion that *C. capsularis* L. was not wild in India, Malaya and China. Kundu (1951) argued that *C. capsularis* L. is not an immigrant as stated by some authors, but its centre of origin is Indo-Burma, which according to Vavilov's map includes South China.

The two cultivated species of jute differ from each other in respect of different morphological characters. The roots of *C. capsularis* L. are shallow penetrating and bushy, while those of *C. olitorius* L. are deep penetrating and are comparatively less bushy. The *olitorius* plant is generally taller than the *capsularis* plant. The *olitorius* leaves have a shining upper surface and a rougher under surface and are almost tasteless when chewed. In case of *C. capsularis* L., the leaves are glabrous and ovate, although they too are oblong and coarsely toothed like leaves of *C. olitorius* L. The *capsularis* leaf generally tastes bitter upon
chewing; though there are a few non-bitter types also in this species. The flowers of *C. olitorius* L. are larger than those of *C. capsularis* L., with 5 to 6 sepals; 5 to 6 petals which are yellowish in colour, entire or split; 30 to 60 stamens; elongated ovary, 5 rarely 6 or more carpelled, syncarpous; usually 40 ovules in each loculus with axile placentation and with glabrous and entirely pubescent stigma. In *C. capsularis* L., on the other hand, the flowers consist of 5 sepals; 5 petals; 20 to 30 stamens; rounded ovary, 5-carpelled, syncarpous; usually 10 ovules in each loculus with axile placentation; pubescent 2-3 ftd stigma. Anthesis takes place an hour or two after sunrise in *C. capsularis* L. and an hour or less before sunrise in *C. olitorius* L. Both the species are regarded as being self-pollinated, but they differ in the extent of cross-pollination. In *C. capsularis* L., the extent of cross-pollination is 2 to 3%, while in *C. olitorius* L., this is 12% on the average (Ghose and Dasgupta, 1945; Hoy, 1960). The pod of *C. capsularis* L. is roughly globular and hence it is called capsule, while that of *C. olitorius* L. is cylindrical. The seeds of *C. capsularis* L. are smaller in size than those of *C. olitorius* L. and are copper coloured. The seeds of *C. olitorius* L. are bluish green to steel grey in the cultivated varieties and steel grey to black in the wild varieties. The two species differ in the quality of fibre. The fibre of *olitorius* is finer, softer, stronger and more lustrous than that of *capsularis*. The colour of *capsularis* fibre is whitish and hence called 'white jute' by the trade. The *olitorius* fibre is yellowish, reddish or greyish in colour.
There are a number of well defined varieties, within each of these two cultivated species, based on various characters such as pigmentation, pod shape and size, petal and anther colour, taste of leaves, earliness and tallness, yield and quality of fibre etc. (Burkill and Finlow, 1907; Patel et al., 1944; Patel and Sanyal, 1945). A note on the agronomy of jute crop is given in Appendix A.

Different breeding techniques, particularly selection and hybridization, suitable for a self-pollinated crop are usually employed in this crop also. Mutation and polyploidy have also been employed though not yet with tangible economic results. One of the outstanding constraints in revolutionizing the breeding prospects in jute is the presence of inter-specific cross-incompatibility barrier between the two cultivated species (Ganesan et al., 1957; Iyer et al., 1961; Patel and Datta, 1960; Patel and Ghose, 1940; Sachar et al., 1964; Srinath and Kundu, 1962). Numerous attempts have been made in this direction (Islam, 1964; Islam and Rashid, 1961; ), but all these efforts have not yet yielded any tangible result at least in so far as obtaining interspecific hybrid seed on a commercial scale is concerned. Due to the prevalence of such incompatibility barriers, the desirable characteristics of C. capsularis L. such as comparatively greater resistance to flood and drought, and those of C. olitorius L. such as disease and pest tolerance and better and stronger fibre quality etc. could not be combined in a single hybrid.

Mutation and polyploidy techniques used in this direction have also failed so long to solve this problem of combining the character-
istics of the two species into one hybrid. As an alternative, therefore, it may be worthwhile exploring the possibility of improving the respective deficient or undesirable characters in either species by enhancing the efficiency and effectiveness of mutations and polyploidy as direct tools in selection and breeding in the desired direction.

In the realm of application of mutagens to this important crop plant, overwhelmingly major attention has so far been paid to the assessment of mutagenic sensitivity of the different cultivated varieties and on the induction of major phenotypic changes as one of the ways for effecting improvement. On the other hand, another recent but important field of mutation breeding i.e. induction of small changes due to mutational events in polygenes has not yet gained sufficient appreciation in this crop. The significant lacuna in obtaining desirable types through mutation technique in jute, is also understandable in the light of the findings of Gustafsson (1947) that qualitatively inherited or drastic mutations tend to be predominantly deleterious. Lack of methodological approach in breeding for micromutations may be attributed to absence of comprehensive understanding of the ways in which they express themselves in a treated population. Oka et al. (1968), Krull and Frey (1961) and Abrams and Frey (1964) reporting on their works with micro-mutations of different crop plants concluded that mutations which affect quantitative attributes form a rather normal distribution of plus and minus effects around a mean. Hence, despite an occasional drastic mutant proving useful, the greatest utility of
mutation breeding, as Frey (1964) has correctly emphasized, will be with quantitatively inherited attributes. Brock (1964) pointing out the polygenic nature of most of the economic traits, has rightly commented that the main efforts of modern plant breeder should be devoted to handling such characters. Similar opinions were also put forward by Somoroli (1963), Balint (1964), Gaul (1964) and Swaminathan (1969).

Another important aspect of mutation studies deals with the question of effectiveness and efficiency of mutagens as influenced by different environmental or modifying factors. Most of the works so far reported in this direction deal with mutagen induced large effects (Caldecott and Smith, 1962; Konzak et al., 1964; Nilan et al., 1964; Smith and Caldecott, 1948; Wallace, 1961a, 1961b, 1964a, 1964b). Mutagenic effectiveness is defined as the rate of "point" mutations per unit dose/concentration of mutagen, while mutagenic efficiency is related with the production of desirable changes free from association with undesirable changes (Konzak et al., 1964; Nilan et al., 1964). This idea may also be extended
to the field of polygenic variability for different economic characters. In such a case effectiveness may be expressed as the magnitude of variability per unit dose/concentration of a mutation, while efficiency may be expressed as the magnitude of variability induced in the desirable direction of selection for a particular character with the mean value of that character also getting shifted towards the desirable direction.

Induction of variability for different economic characters and efficient selection programmes based on such induced variability are two important avenues for realizing the success of mutation breeding in self-pollinated crop plants. To formulate efficient selection programmes based on induced variability, knowledge of changed associations of causal characters with resultant character and inter se as well as knowledge of changes in the path ways through which the resultant character is determined by the causal characters may be of immense help.

In the light of the above reasoning, an elaborate work on jute mutagenesis was designed to pursue the following principal objectives:

Assessment of the influence of different environmental factors on the mutagenic action of x-ray and Diethylsulphate (dES) in inducing polygenic variability in characters of a capsularis (Bud-Bud-1) and an olitorius (JHO 878) variety of jute.

Study of the extent of changes in character associations of the above two jute varieties with special reference to the influence of different environmental factors on the mutagenic actions of x-ray and dES.

Study of the roles of different environmental factors in exerting influence upon x-ray and dES in inducing visible mutations in the above mentioned varieties.

The results of these studies carried out from 1971 to 1974 have been presented and discussed in the following pages.