INTRODUCTION

Mutation experiments, besides leading to the understanding of the fundamental mechanisms of the process, help to provide genetic variability and produce specific mutation that may confer a desired character on an otherwise superior variety. Induced mutation is a unique approach to plant breeding; it often represents the only possible method of creating a character which is not found in natural population, and is the easiest and quickest method if the desired character is part of an undesirable genotype. It offers a method of breaking tight linkages, producing translocations for gene transfer and is an invaluable tool for cytogenetical studies of any particular plant species.

A large part of the usefulness of mutation work rests on increasing the efficiency of mutation production. The final output of the mutants depends on both the methods of original induction and those of selection. In obtaining desired mutations and to increase the mutation rate, the choice of proper mutagen in an appropriate dose is evidently the prime consideration. It already appears that the chemical mutagens can provide a valuable tool towards investigations of the experimental control of the mutation process. By using chemical mutagens it has been possible to induce mutations (Auerbach, 1943; Oehlkers, 1943; Rapoport, 1948) rarely or not at all realised in radiation experiments (Fahmy and Fahmy, 1957).

Among the chemical mutagens, the unique features of alkylating agents have been demonstrated in various ways by a

number of workers (Auerbach, 1958; Ehrenberg, 1960; Ross, 1962; Moutschen, 1964; Gustafsson, 1963) and the wide potentiality of this group has been often utilized in the improvement of plant species. In phanerogam species, two such compounds, ethyl methanesulphonate and ethylene oxide, have induced higher mutation rates than those obtained with radiations (Gustafsson, 1960).

Since the pioneering research of Buzzati-Traverso and Scossiroli (1958) on the polygenic mutations in Drosophila induced by radiation, it has been established that induced mutations can also be used in crop plants to generate useful variation in quantitatively inherited characters and, where appropriate selection has been applied, improvements in numerous traits (Sigurbjornsson and Micke, 1969) including adaptability (Bogyo et al., 1969), maturity time (Brock, 1970) and yield (Gregory, 1968) can be obtained.

In recent years a number of workers have attempted to assess the radiation induced variation in quantitative characters and have estimated the progress that can be made by subsequent selection. An increase in variance irrespective of characters, symmetrical or skewed, has been the general observation while the mean mostly remained unchanged and sometimes decreased.

One of the hypotheses forwarded to explain such behaviour of induced mutations in quantitatively inherited variation (Brock, 1965) is that random mutation is expected to increase the variance and shift the mean away from the direction of previous selection. The symmetry of the induced mutation and the effectiveness of selection applied to the mutated population are determined by the

intensity of previous selections. Gregory (1968) has already postulated that mutants of very small phenotypic effect will occur with high frequency and will have an equal probability of being positive or negative in their phenotypic effect. The other hypothesis (Gaul and Aastveit, 1966) assumes that the underlying gene reactions associated with mutations of quantitative characters are not related to genotypes or even to species. With random mutation a change in the mean value of almost any quantitative character is to be expected in a direction associated with the vitality.

In fact, our knowledge about the different ways mutagens can react with different genotypes and influence the nature, frequency and direction of mutations, particularly for quantitative characters, is extremely limited. There also exists serious deficiency in the information about the influence of chemical mutagens on quantitative characters. It is quite likely that chemical mutagens may provide a better understanding as they induce much higher mutation rate and cause less disturbance to the genetic balance than do radiations. Added to this, the use of diverse genotypes and the analysis of different quantitative characters are likely to establish the nature of induced variation in continuous characters. The chance of success in a mutation breeding programme is largely a function of population size, mutation frequency and efficiency of selection (Brock, 1971).

The choice of rice as the genotype needs no emphasis as it is a vital agricultural commodity and is the staple food of about half the world population. Cultivated rice is an excellent material for plant research (Gustafsson, 1966) and offers

opportunities for successful application of fundamental research, including mutation induction practice. Countless problems need to be solved before rice plants can be evolved which meet the varied demands presented by the different agro-climatic conditions and consumer needs in the vast rice growing area. Inspite of the recent synthesis of high yielding rice varieties (which have their limitations) many regional varieties have their adaptational advantage and may also form convenient experimental material for mutation induction.

In the present investigation the two varieties that have been chosen include Dular, which is an old, intensively selected regional variety, and IR8, a recent high yielding introduction which has not undergone intensive selection. These germplasms are likely to provide information on the controversial question about the relation of genotype and previous selection to the nature of mutation induction and selection response, for different quantitative characters.

In view of these considerations and also of the lack of information on chemical mutagenesis in rice, particularly regarding quantitative mutation, the present investigation has been taken up to study (i) the mutagenic effects of two alkylating agents, ethyl methanesulphonate and ethylene oxide on rice (Oryza sativa), (ii) the characteristics and cytogenetic analysis of the mutants, (iii) the nature and amount of induced variation in quantitatively inherited traits contributing towards yield, and (iv) the consequence of selection including isolation and evaluation of beneficial mutants.