MUTATIONS

Mutation is the permanent alteration of the nucleotide sequence of the genome of an organism, virus or extrachromosomal DNA or other genetic elements. Mutations results from error during DNA replication (especially during meiosis) or other type of damage to DNA (such as may be caused by exposure to radiation or carcinogens) which then may undergo error-prone repair (especially microhomologymediated end joining) or cause an error during replication (translesion synthesis). Mutations may also result from insertion or deletion of segments of DNA due to mobile genetic elements.

Radiation induces mutation to develop new variety of crops. Now with newer & more powerful sources of radiations (UV shortwave, Xray, Alpha, Beta & Gamma waves) & many chemicals (mutagens) e.g. caesium, ethyl methane sulfonate, nitromethyl (urea) we can increase the rates of mutations. Collectively ionizing radiation & chemicals will produce a mutation spectrum. The former, however, produce in the chromosomes, aberrations of a more random nature than chemicals which often act principally at certain Loci-particularly at those areas of the Chromosomes which stain differently at mitosis (heterochromatin). Also, the distribution of effects between nuclei is mere random with x-rays than with chemicals.

Mutagenic agents act as various stages of nuclear organisation. Thus at the stage of interphase (nondividing) nucleus when DNA synthesis is taking place, aberration involving chromated exchanges & isochromatid breaks occur. These effects do not become immediately (0-8 hours) manifest in the call but appear as delayed effects (8-48 hours) after treatment. Ionizing radiation & most chemicals produce aberration of this type. Clearly breaks which occur in the interphase nucleus chromosomes before DNA synthesis occurs (chromo-

somes unsplit) would be of the chromosomes type & these are induced by X-ray treatment & by the chemicals (ethoxycaffeine & streptongrin). Other mutations may be induced during DNA post-synthetic stage of the interphase nucleus & during mitosis itself- as in the production of polyploids by colchicine & in the inducement of binucleate or polynucleate conditions due to inhibition of cell plate formation by cyclic organic compounds (e.g. halogenated derivatives of benzene & toulene, hydrazinotropone compounds, aminopyrine).

Factors which may influence the effect of mutagenic treatment includes oxygen tension within the tissues, temperature & pH. Chemical mutagens can be applied in a similar way to colchicine. Seeds, whole plants, isolated organs, growing points etc. are suitable for direct irradiation. Inorder to obtain single mutation in plant irradiation of pollen which is subsequently used to fertilise normal flower is often advantageous. It is unlikely that a pollen grain will retain its viability if it undergoes more than one mutational change.

Among plants of medicinal interest the Blakesledee radiation work *Datura Stramonium* resulted in the production of vary single gene mutation type (e.g. Zigzag, Ouercina, Banchy, Equisetum-names derived from some characteristic aspect of plant). These mutants are not isolated individually but are produced regularly by radiation treatment. Some forms such as pale (chlorophyll-deficient) are more frequent than others. In many cases Blakeslee was able to map the formation of genes responsible for these effects. Other mutants obtained in these studies were of the extra-chromosomal type.

Hybridization : In plant breeding, hybridization forms a possible means of combining in a single variety the desirable characters of two or more lines, varieties or species & occasionally of producing new & desirable characters not found in either parents. Hybridization particularly between homozygous strains which have been inbreed for a number of generations, introduced a degree of heterozygosity with resultant hybrid vigour (heterosis) often manifest in the dimensions & other characteristic of plant. There are several methods of breeding crops by sexual hybridization but in this topic more emphasis is given on chemical variants of a particular species in addition to intervarietal hybridization, interspecific hybridization in which hybrid vigour is also apparent.

The hybrid nature of number of drugs is well known. In the genus *Datura* the effect of hybridization on chemical constituents is illustrated by the cross *D.Ferrox* x *D.stramonium*. The aerial organs of the later normally contains hyoscyamiae & hyoscine (2:1 ratio) at the lowering period; and those of the former hyoscine with some metelodine. The F_1 of the cross consists of plants larger than either of the parents & containing hyoscine as the principal of alkaloid with only small amounts of other basis. In the F_2, segregation occurs as regards with morphological characters & alkaloid constituents with *D.leichhardin and D. innoxia* the former plant produces hyocyamine & hyoscine (2:1) & the later species usually mainly hyoscine but sometimes according to conditions of growth appreciable quantities of hyoscyamine. In this instance the F_1 hybrid contains a hyoscyamine : hyoscine ratio intermediate between that of two parents.

Nicotiana tobacum as now cultivated must have been derived from at least two different plant species & synthetic tobacoos can be prepared by using suspected species as parents. Although it has not been possible to produce in this way exactly comparable to *N.tobaccum*, such synthetic plants are most useful for the study of alkaloid inheritance characteristic. This is important in commercial production of tobacco, in which both the quantity & nature of

alkaloid produced are important. Demethylation of nicotine may take place in the leaves of some species & by hybrid studies this reaction has been shown to be due in the group of plants studied to either one pair of dominant factors or two pairs of dominant & indegendent factors.

The preliminary studies carried by Cornish et al in 1983 showed that foenugreek seed, a potential source of diosgenin is capable of genetic improvement regarding the monohydroxysopogenin yield by hybridization of various races of *Trigonella foenum-graecum.*

The inheritance of opium alkaloids (morphine, codeine, thebaine, narcotine & papaverine) has been studied in the cross *Papaver somniferum x P.setigerum.* A heterotic increase in Iodeine & thebaine was found in different F_1 plants & in the F_2 plants, with the exception of codeine, some increase in alkaloid content was noted. As absence of narcotine was generally dominant over the presence. A continution of this work to the F_8 generation resultant in population that was completely diploid but which showed considerably diverting with regard to opium content of morphine, narcotine & papeverine. The patterns of alkaloids was closer to that of *P.somniferum* than to that of *P.setigerum* with morphine contents ranging from 8 to 30%. It was envisaged that a suitable breeding programme could result in opium with higher level of morphine that was normally encountered. F_1 hybrids of *P.bracteatum* and *P.orientale* contained a lower thebaine content & higher oripavine content than in either parent, a result which provided genetic evidence for the biosynthetic linkage between these alkaloids.