

MUTATIONS, MUTAGENS, CROP PARTS TO BE TREATED
AND METHODS OF TREATMENT

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Mutation - described as changes in the sequences of four bases which provide the informational content of DNA.

The bases are:

Purines	:	Adenine	(A)
		Guanidine	(G)
Pyrimidines:		Thymine	(T)
		Cytosine	(C)

In double stranded DNA these are arranged in 4 base pairs

A.T., T.A., G.C. and C.G.

When one base pair is replaced by another, the change is called a base or base pair substitution

Base pair substitution (can be of two types)

Transition	Transversion
(A purine is replaced by the)	(A purine is replaced by a)
(other purine and at the same)	(pyrimidine and a pyrimidine by a)
(time a pyrimidine by the)	(purine, e.g. A.T. → T.A. or)
(other pyrimidine, e.g. A.T. → G.C.) (A.T. → C.G.)
(or G.C. → A.T.) ((Freese, 1959))

Mutation can also result from the addition or deletion of one or more base pairs. Such changes called frameshift mutations (Drake, 1970), are important for their ability to disrupt gene function.

A comprehensive review on the theory of mutation has been published by Drake et al (1983) and on spontaneous mutagenesis by Sargentini and Smith (1985).

Probable conclusions from these reviews are that each kind of mutation has a unique set for its induction and manifestation.

Although considerable progress has been made, the actual mechanism of mutation induction may not have been found yet.

From Brunner 1985 "Methods of Induction of Mutations" Adv. pr. Br. methods (Ganguli P.K. & Mandal A.K. eds.). Oxford & IBH Pub.Co. New Delhi.

MUTAGENS

Mutagens are agents which bring about Mutations.

Two types: Physical
Chemical

Most useful to cultivated plants are:

Physical : X-rays, Gamma-rays, Neutrons (fast and thermal)
Chemical : Ethyl methanesulphonate, diethyl sulphate dES,
Ethyleneimine (EI), Ethyl Nitroso Urea (ENH),
Methyl Nitroso Urea (MNH) and Sodium Azide (NaN_3)

Radiation damage in a cell population is random.

Some cells die, others are not subject to ionizing events.

Ionizing radiations → produce chromosomal aberrations, e.g.

Bridges, inversions, translocations, deletions, etc.

Chromatid or single strand breaks result into simple deletions,

sister unions and gene mutations and are caused by single ionizing events.

Chromosome or both chromatid breaks result from two ionizing events; cytologically manifested as translocations, rings, discentrics.

Mutagen treatment methods:

Acute - Short time exposure; higher dose

Chronic - long period exposure (days/months/years); lower dose.

Recurrent-Irradiation in subsequent generations; lower dose; possible gain in frequency of mutations is too small compared to time and labour required.

Combined -A combination of physical and chemical mutagen treatment.

Plant Parts to be treated:

- Whole plants: in gamma-fields or gamma-rooms; small plants or seedlings can be treated with gamma sources, X-ray machines
- Seeds: apical meristem or embryo.
- Pollen or both gametophytes. Advantage is that pollen irradiation does not produce chimeras i.e., M_1 plant resulting from pollination of unirradiated egg cells by irradiated pollen will be fully heterozygous for any induced mut.;

disadvantage; short viability of pollen

- Buds, tubers, bulbs, stolons, cuttings
- Cells or tissues in culture.

Preparation for seed treatment with radiation

Seed should be equilibrated to 12 - 14% water content before irradiation. This is done

- for decreasing seedling injury
- " " storage effect (upto 4 weeks at 20-25°C)

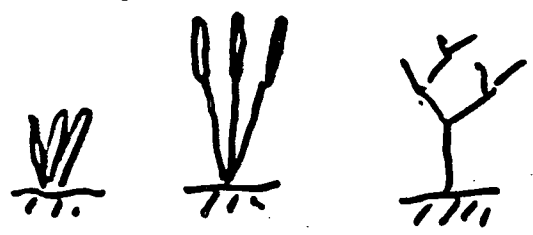
Treatment procedures of physical and chemical mutagens to various plant parts will have to be collected from published literature.

Handling and disposal of chemical mutagens.

Please see Handout.

Objects of mutagen treatment

1. Whole plants



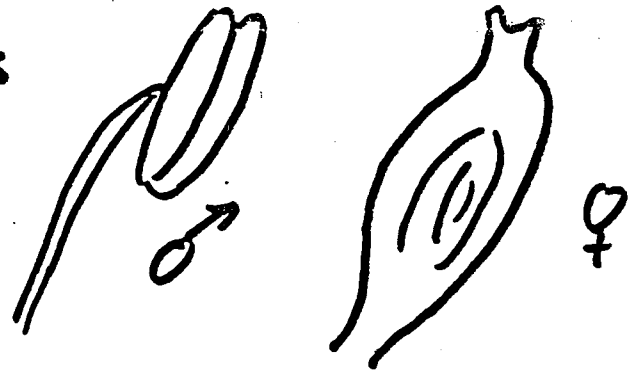
2. Seeds



→ apical meristem



3. Gametophytes



4. Cells or tissues in culture



5. Tubers, bulbs, corms, stolons, cuttings, etc

