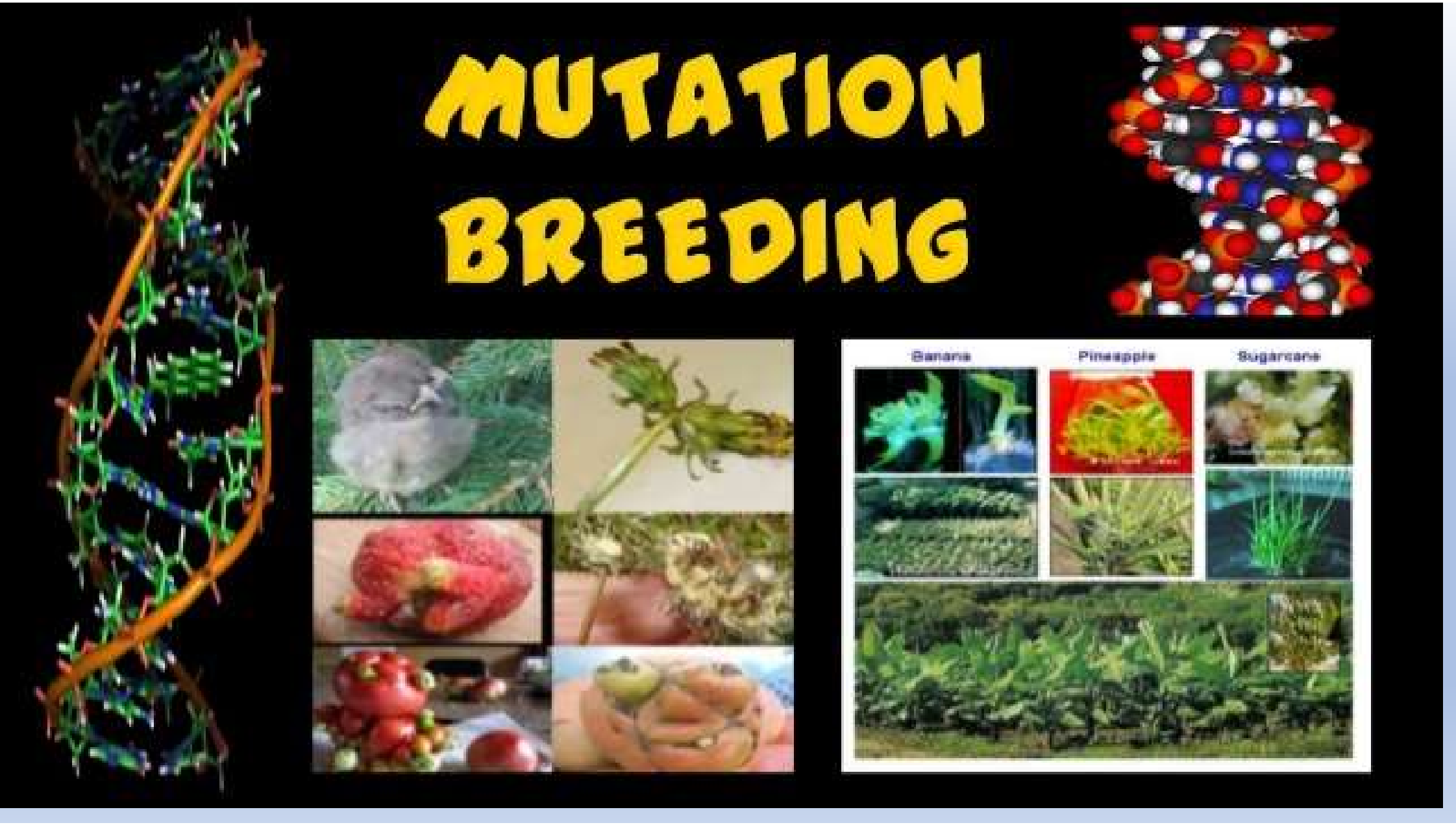

MUTATION
BREEDING
Banana
Pineapple
Sugarcane

MUTATION BREEDING

- Inducing desirable mutations and exploiting them for crop improvement. It is commonly used in self pollinated crops and used to produce traits in crops such as larger seeds ,new colour.
- Important steps to know before mutation breeding are,

1.Selection of variety for mutation breeding- It should be the best variety available in crop and Seed shold be pure

2.Part of the plant to be treated

3.Dose of the mutagen- Mutagens generally induce a high frequency of chromosomal changes and meiotic and mitotic irregularities, Optimum mutagen dose is one, which produces maximum frequency of mutations and causes the minimum killing.

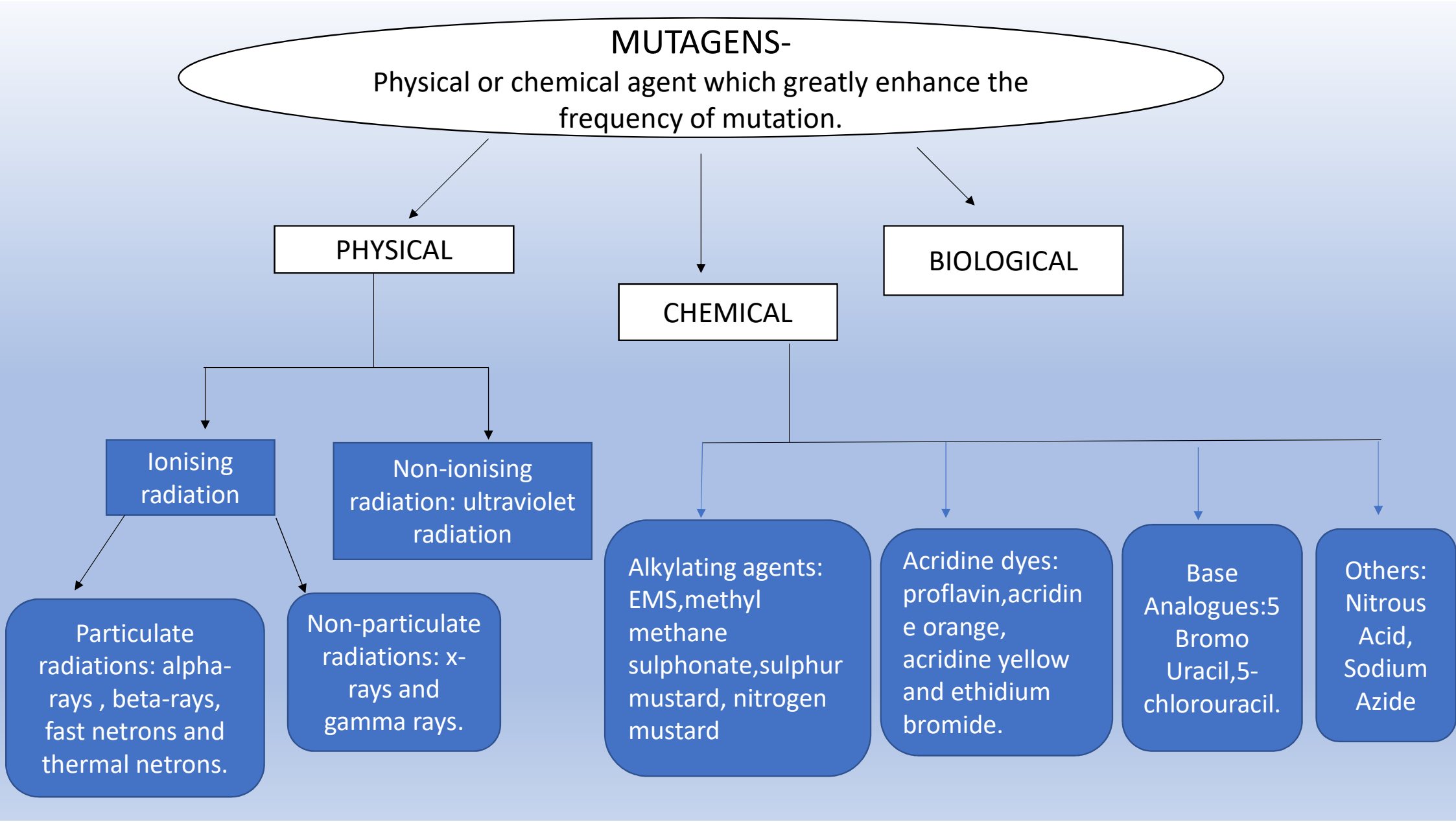
TYPES OF MUTATION

A. Spontaneous mutations : Mutation occur in natural populations .

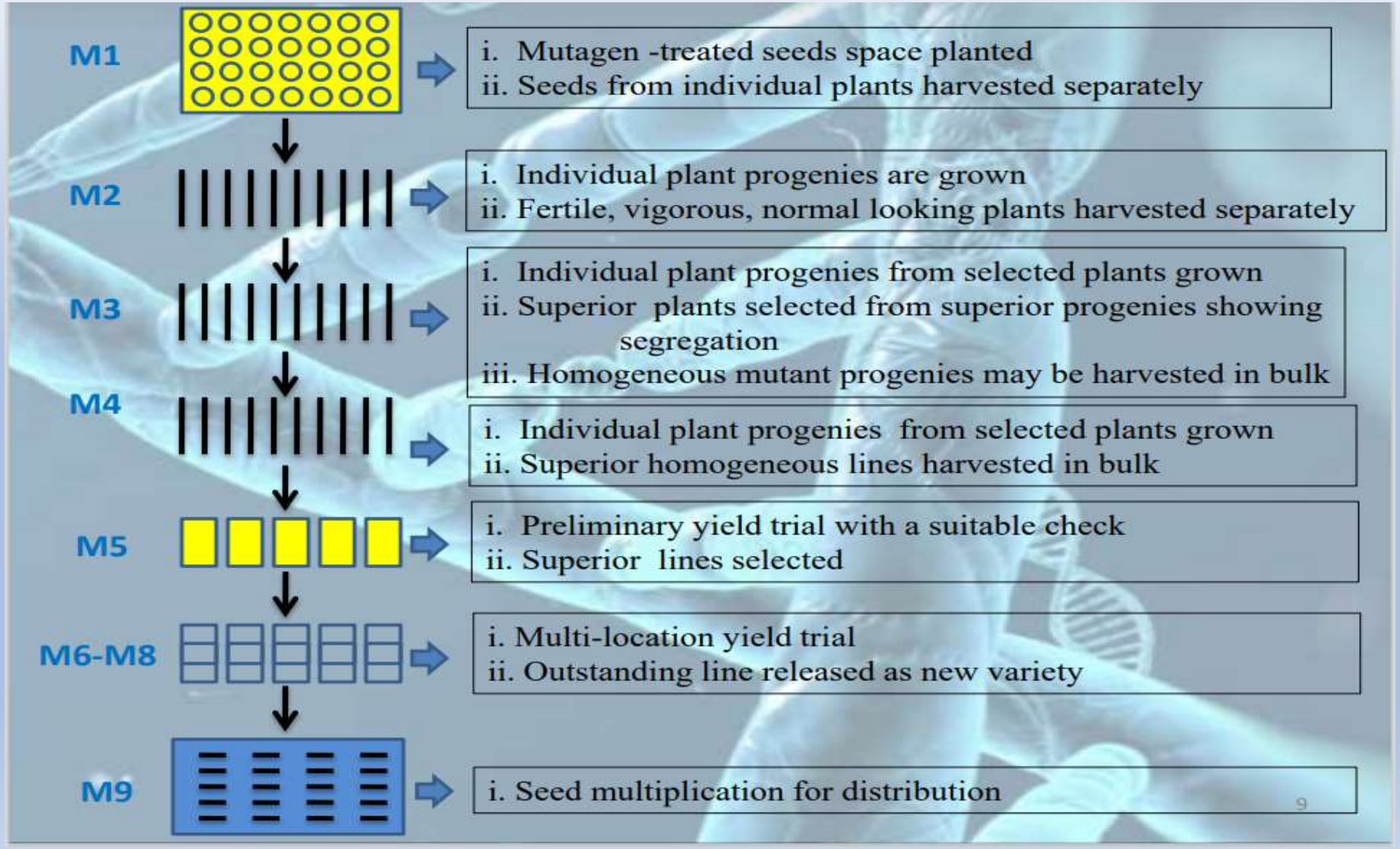
B. Induced mutations: Mutation may be artificially induced by various mutagenic agents. Induced mutations are of two types:

1.Macro-mutations: Mutation with distinct morphological changes in the phenotype.

2.Micro-mutations: Mutations with invisible phenotypic changes.


MUTAGENS-
Physical or chemical agent which greatly enhance the frequency of mutation.
PHYSICAL
CHEMICAL
BIOLOGICAL
Ionising radiation
Non-ionising radiation: ultraviolet radiation
Particulate radiations: alpha-rays , beta-rays, fast netrons and thermal netrons.
Non-particulate radiations: x-rays and gamma rays.
Alkylating agents: EMS,methyl methane sulphonate,sulphur mustard, nitrogen mustard
Acridine dyes: proflavin,acridine orange, acridine yellow and ethidium bromide.
Base Analogues:5 Bromo Uracil,5-chlorouracil.
Others: Nitrous Acid, Sodium Azide

BREEDING PROCEDURE



Screening/selection

Mainly three types screening/selection techniques are used in M2 and subsequent generation.

1. Visual : most effective and efficient method for identifying mutant phenotypes.

2. Mechanical/Physical : Very efficient for seed size, shape, weight, density, etc., using appropriate sieving machinery.

3. Other methods : Low alkaloid content mutants can be selected using colorimetric tests. - chromatographic or electrophoresis techniques may be used to select isolate protein variants

Advantges

a) Mutation breeding is a cheap and rapid method of developing new varieties.

b) Induced mutagenes is used for the induction of CMS. Ethidium bromide (EB) has been used for induction of CMS in barley.

c) Mutation breeding is more effective for the improvement of oligogenic characters.

d) Mutation breeding is the simple, quick and the best way when a new character is to be induced.

Limitations

a)The process is generally random and unpredictable.

b) Useful mutants are rare and predominantly recessive.

c) Mutants can have strong negative pleiotropic effects on other traits.

d) Health risks: handling, chemical mutagens; radiations, fast neutrons treatments.

e) Most mutants are of no use to breeding even if a large number of mutants can be produced.

f) Field trialling and germplasm storage can be expensive and require a lot of space and careful management if large mutant populations are handled.

The primary research centres and institutes in India that participated in the development and release of various mutants

- Indian Agricultural Research Institute (IARI)- New Delhi
- Bhabha Atomic Research Centre- Mumbai
- Tamil Nadu Agricultural University –TN and
- National Botanical Research Institute – Lucknow, UP

Achievements of mutation breeding :-

- Higher yield Barley (DL 253), Pea (Hans), Groundnut (Co 2, TG 17).
- Short stature Barley (RDB 1),Rice (Prabhavati).
- Earliness Rice (IIT 48,IIT 60,Indira,Padmini)
- Stress resistance Salt tolerance in Rice (Mohan)
- water logging tolerance in jute (Padma)
- Bold seed size Groundnut (PB 1,PB 2,Vikram) and Rice (Jagannath)

Mutant Varieties developed

1. Genetic enhancement of rice -The first rice varieties KT 20-74 and SH 30-21, developed through induced mutation, were released in China in 1957 and the first variety Yenhsing-1, developed by a cross- breeding programme with a mutant.

2. Developing draught and salinity tolerance in wheat crop -'Sharbati Sonora' produced from red grained Mexican variety 'Sonara 60' by gamma irradiation at the Indian Agriculture Research Institute, New Delhi, India.

3. Enhancing lodging resistance in Barley crop :– Centenario, high yielding, high protein content, early maturity and resistance to yellow rust, was released in 2006 contributes significantly to the food security of the country.

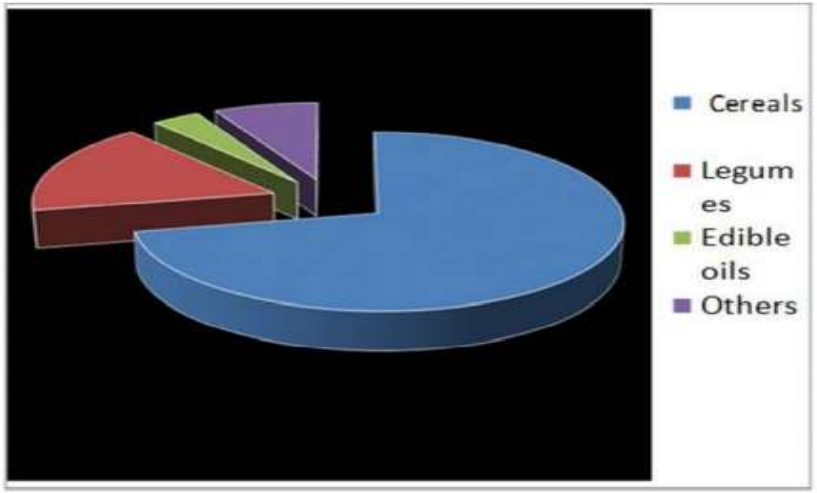
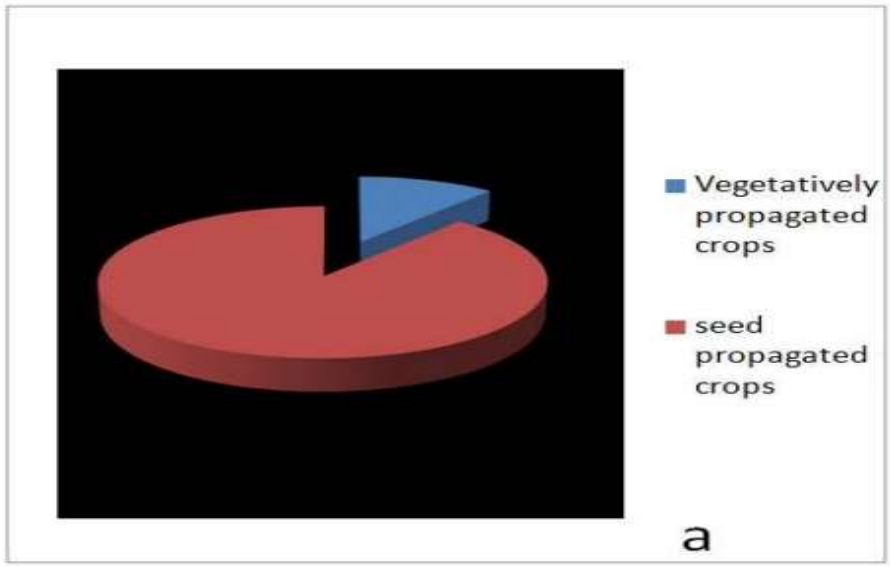


Fig. Number of released varieties developed through mutation breeding in cereals and legumes

Data source: Officially released mutant varieties The FAO-IAEA Database, 2000

4. Developing early maturing varieties of peanut -Several peanut mutants (Yueyou No. 5, Yueyou No. 22, Yueyou No. 33, Yueyou 551, Yueyou 187) induced with gamma radiation were released in China.

5. High yielding and wilt disease resistant chickpea mutants A series of High Yielding and Wilt Disease Resistant Chickpea Mutants such as Pusa – 408 (Ajay), Pusa – 413 (Atul), Pusa – 417 (Girnar), and Pusa – 547, developed at I.A.R.I., New Delhi.



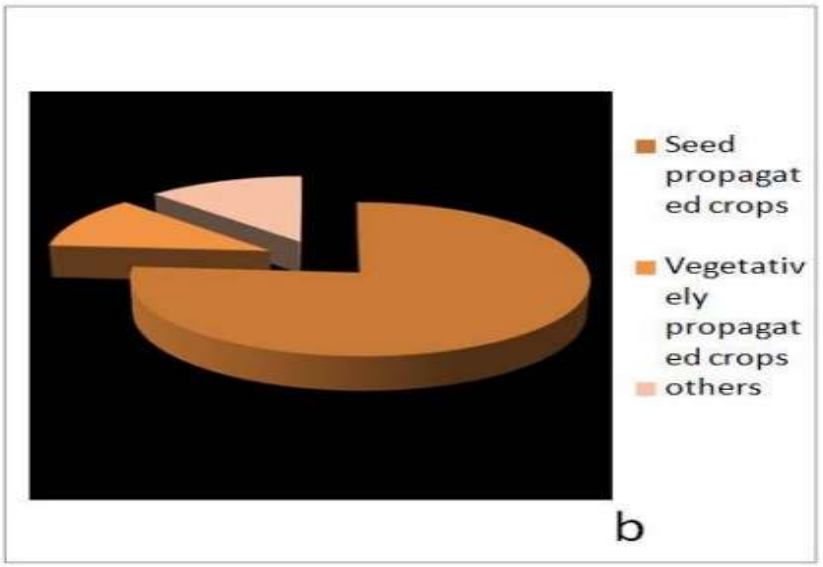


Fig. Officially released mutant varieties by mode of propagation: a, in December 2000; b in May 2015

Data source: Induced Plant Mutations in the Genomics Era. Food and Agriculture Organization of the United Nations, Rome, 2009, 262-265; FAO/IAEA, 2015

Case study- a.Wheat

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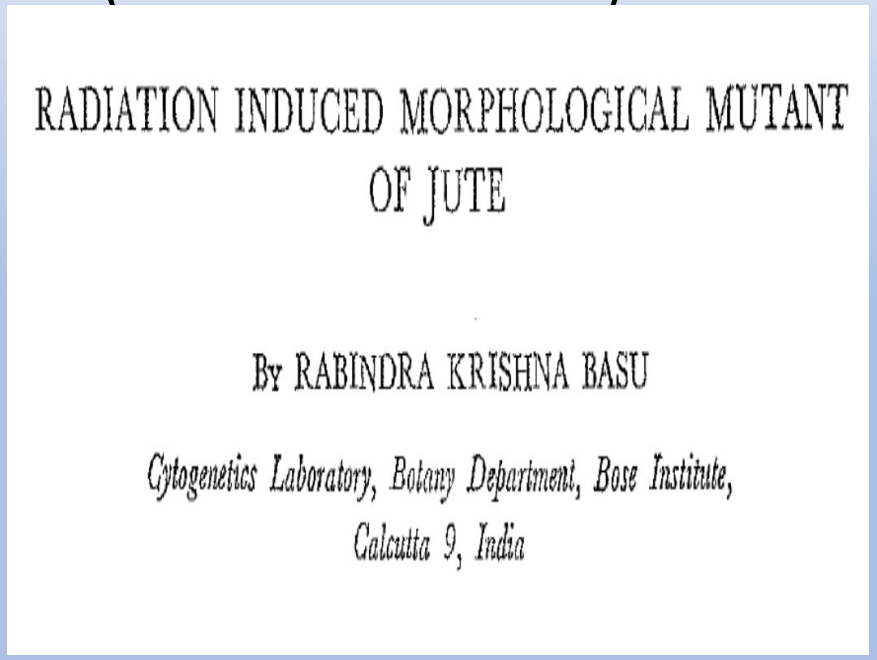
Induced Mutations in Bread Wheat (*Triticum aestivum* L.) CV. 'Kharchia 65' for Reduced Plant Height and Improve Grain Quality Traits

[1]N.K. Singh and [2]H.S. Balyan

[1]Department of Biotechnology in Applied Mechanics,
Motilal Nehru National, Institute of Technology, Allahabad, 211 004, India
[2]Department of Genetics Plant Breeding, Ch. Charan Singh University, Meerut, 250 004, India

- An old tall cultivar of bread wheat (Triticum aestivum L.) cv. 'Kharchia 65' was used in this study.
- Treated with acute doses of 10, 20,30 and 40 kR of gamma rays at the rate of 5.6 r/second from gamma cell at Genetic Division , IARI.
- Mutants characterized by reduced plant height, square head, awnless ear, amber seed colour, bold seeds and storage capacitie

B.JUTE:-Jute is also called the golden fiber for its color and high cash value. • Two types White jute(Corchorus capsularis) and Tossa jute (Corchorus olitorius)



RADIATION INDUCED MORPHOLOGICAL MUTANT OF JUTE

By RABINDRA KRISHNA BASU

Cytogenetics Laboratory, Botany Department, Bose Institute, Calcutta 9, India

- Variety used – D 154
- Mutagen - 18,000 r X-rays

RESULTS

- The leaves were much smaller in size than those of the control plants.
- The differences in plant height, basal diameter, and leaf dimensions

FUTURE PROSPECTS

- Induced mutagenesis is gaining importance in plant molecular biology as a tool to identify and isolate genes and to study their structure and function which will definitely have a major impact on the future crop improvement programmes.
- Mutation in association with the new technology of genetic engineering will constitute tools of plant breeders in near future.
- Recently, heavy ion beam irradiation has emerged as an effective and efficient way of inducing mutation in many plant varieties because of its broad spectrum and high frequency
- The induced mutation has also proved useful in the preparation of genetic maps that will facilitate molecular marker assisted plant breeding in future.
- Mutation breeding has become increasingly popular in recent times as an effective tool for crop improvement.Crop varieties generated through the exploitations of mutation breeding are significantly contributing to global food and nutritional security and improved livelihoods.