

REVIEW ON INDUCED MUTAGENESIS

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INTRODUCTION

The credit of introducing term “mutation” goes to Hugo de Vries while working on *Oenothera lamarckiana* (evening primrose). But the initiation of regular mutagenic studies was done by T. H. Morgan, who discovered white eyed mutants of *Drosophila melanogaster* Meigen (fruitfly) among red eyed population. Due to chance event of occurring spontaneous mutation in nature, scientists was urge to develop alternative mechanism and explore new approach of inducing mutation. This landmark of genetics has been achieved by H.J. Muller in 1927, with the discovery of mutagenic potential of X-rays in *Drosophila melanogaster*. However the pioneer endeavor of inducing mutation in crop species was successfully performed by Stadler (1928), who discovered X -rays induced mutation in Barley. After that various scientists performed mutagenesis experiment using X-rays to discover efficiency of X-rays in inducing mutation.

In 1936, mutagenesis studies received its beaktrough, when when the first induced mutant tobacco var. ‘chlorina’ was released using X-rays in Indonesia. They recognized light green color of leaves which were chlorophyll deficient.

STUDIES ON INDUCED MUTAGENESIS

In the current epoch induced mutagenesis provides a chance to generate hitherto unidentified alleles heading to broad genetic variability (Raina *et al.*, 2016).

In expanding population while no sufficient arable land will be left, ultimately there will be food crisis. The massive advent of induced mutation breeding is expected to guarantee a sound solution to extra increase in food production by both increasing grain production and stability.

Till several centuries during ancient times, induced mutations have contributed enormously to the expansion of superior varieties in numerous crop plants. Till now, 3,218 mutant varieties have been released globally.

PHYSICAL MUTAGENESIS: GAMMA RAYS

Gamma rays are regarded as highest energetic form of electromagnetic radiation and they possess an energy level from 10 keV (kilo electron volts) to several hundred keV. Gamma rays have most penetrating power as compared to alpha and beta rays (Kovács and Keresztes 2002).

Gamma rays falls in the category of ionizing radiation as these radiations generate free radicals in the cell after interaction with atoms or molecules. These free radicals contact the cell to damage or sometimes modify the cell and its component and therefore reported to have deep persuaded on plant growth and

development by causing genetical, cytological, biochemical, physiological and morphogenetic alteration in cells and tissues depending on the intensity of irradiation (Gunkel and sparrow 1961; Akshatha *et al.*, 2015). Such effects leads to changes in the plant cellular structure and metabolism e.g., dilation of thylakoid membranes, modification in photosynthesis, modulation of the antioxidative system, and accrual of phenolic compounds (Kim *et al.*, 2004; Wi *et al.*, 2005).

UV Rays

Maxwell (1865) proposed the theory of electromagnetic waves. After that a revolution in the field of solar spectrum studies occurred and by 1920, the existence of UV radiation, its properties and relationship to sunlight were well established. The discovery of ultraviolet light as a wavelength occurred in 1800 with Ritter (Berg, 2008). The issue of UV radiation hitting the earth's atmosphere was first noted in 1881 by Hartley when he was able to measure ultraviolet energy hitting the earth's surface and found it varied depending on altitude (Hartley, 1881). The description of the wavelengths occurred not long after with Hertz who developed a method for measuring microwaves. Ultraviolet radiation (UV) is a part of the non ionizing region of the electromagnetic spectrum which comprises approximately 8-9% of the total solar radiation.

Depletion of ozone layer leads to the increase in ultraviolet radiation (UV-B) reaching to the Earth surface (Madronich *et al.*, 1998).

A large number of studies have been conducted to evaluate the potential consequences of an increase in UV-B radiation on many plants (Zheng *et al.*, 2003). In plants, wide inter- and intraspecific differences have been reported in response to UV-B irradiation with respect to growth, production of dry matter and biochemical changes (Mpoloka, , 2008; Fedina *et al.*, 2010; Kramer *et al.* , 1991). Some plant species are unaffected by UV-B irradiation and several are apparently stimulated in their growth, but most species are sensitive and damage results (Teramura 1983).

CHEMICAL MUTAGENESIS- EMS

EMS (Ethyl methane sulphonate) influence a very short segment of chromosome that carries one or several genes, and can change the cytological, genetic, physiological, and morphological traits of plant tissues and cells (Waungh *et al.*, 2006). Various studies have been carried out on the effects of this mutagen on various plants including those conducted by Gandhi *et al.*,(2014);Sengutpa and Datta (2005) and Saba and Mirza (2002) on chilli, sesame and tomato, respectively. Reduction in plant height, primary branches per plant, days required for first flowering, number of pods per plant, pod length, number of seeds per pod and seed yield per plant was recorded at different doses of EMS in horsegram and urdbean (Bolbhat *et al.*, 2012; Goyal *et al.*, 2019).

COMBINED TREATMENT

Mehandjiev (2005) investigated that combined treatments of physical and chemical mutagens induced a wider mutation range, which is of immense importance to the experimental mutation breeding program. It

was further emphasized that the combined treatments enhance quantitative and qualitative changes in the scale of mutations more efficiently as compared to individual treatments (Mehandjiev, 2005).

Sarada *et al.*, (2015) while working on four variety of coriander treated with gamma, EMS and combination treatment and founded decrease in germination percentage, seedling height, shoot length and number of leaves with increase in concentration of mutagens. Combined treatments were found to be more effective in reducing the survival and height of seedlings than single treatments, while EMS caused more drastic effect on seed fertility than rest of the mutagens in the variety Co. 18 of *Sorghum subglahrascens*(Sreeramulu 1971).

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