CHRONIC GAMMA IRRADIATION FOR CROPS IMPROVEMENT AND AGROBIOTECHNOLOGY

Azhar Mohamad

Malaysian Nuclear Agency, Bangi, 43000 Kajang, Selangor, Malaysia

azhar_m@nuclearmalaysia.gov.my

ABSTRACT

Gamma irradiation is one of the most common procedures in plant mutagenesis, which consists of two categories, chronic and acute radiation. Generally, ^{60}Co and ^{137}Cs are gamma radiation sources for radiation processing with relatively high energy (half-life 5.27 years for ^{60}Co and 30.1 years for ^{137}Cs). The energy associated with gamma radiation is high enough to break the molecular bonds and ionise atoms without affecting structure of the atomic nucleus (avoiding induction of radioactivity). Chronic irradiation is an exposure to ionising radiation over an extended period (hours, weeks, months) depending on their nature, sensitivity and research requirements whereas acute irradiation is an exposure to ionising radiation at a short period. The alteration by chronic irradiation is tremendous, resulting in physical appearance, changes in molecular structures and metabolism changes. These changes are random events, inheritable, and the stability depends on cell damages after irradiation at molecular levels. Chronic gamma irradiation produces a wider mutation spectrum and useful for minimising radiation damages towards obtaining new improved traits for commercial values. Continuous exposure at low dose of gamma irradiation results in considerably elevated somaclonal variation frequency without negative effects on natural response. However, there is still lack of data of the response to chronic radiation by plant species or even in other microorganisms that could elucidate the benefit of this technique. A total of 296 locations with 592 Fricke dosimeters were used in dose mapping. Data for absorbed doses from a range between 1m and 10m from the source revealed fluctuations in their height position at the same distance. This phenomenon is known as back scattering effects.

Gamma Greenhouse facility at Malaysian Nuclear Agency comprises an open topped irradiation area of 30 m in diameter (dome shape). The irradiation source is a REVISS RSL6050 double encapsulated 800 Ci ^{137}Cs pencils and allowed to be exposed only when the entire 300 m diameter site is free from personnel. The irradiator system is secured by a sophisticated interlock system, which only allows the source to be exposed when all the prerequisite safety conditions are met, and automatically returns the source to the safe storage position if any safety device is compromised [2].

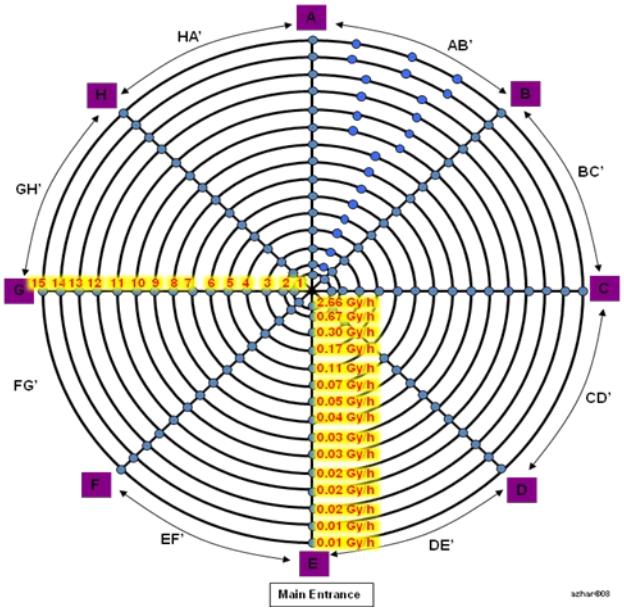

Figure 1. Dose mapping inside the Gamma Greenhouse showing location (with coded system) of specificity dose exposures required for chronic irradiation

Mutation induction by chronic radiation is a successful technique for variety development in creating high somaclonal variations, which affects essential structural genes for useful expression without altering other important traits. The use of chronic irradiation from a ^{137}Cs source at the gamma greenhouse is useful for producing mutant lines. The chronic techniques have made an outstanding impact on the productivity and economic value ranging from food crops and microbes to industrial products for better quality of life. To control and reduce back scattering, lead blocks and/or concrete blocks were used accordingly [1].

KEYWORDS : mutagenesis, chronic irradiation, somaclonal variation

REFERENCES

1. Azhar M. Rusli I., Sobri H. (2009). Gamma greenhouse for chronic irradiation in plant mutation breeding. International Nuclear Conference 09. 29 June-2 July 2009. PWTC, Kuala Lumpur.
2. Rogers N., Stephens P. (2005). Dose rate assessment around shielding wall and sky shine hood for Gamma Greenhouse Facility at Nuclear Malaysia. Report from Powerplus Sys Ltd.