International Journal of Minor Fruits, Medicinal and Aromatic Plants. Vol. 6 (1) : 50-53, June 2020

SHORT COMMUNICATION

Effect of gamma radiation on survival rate of *Allamanda cathartica* – An indigenous medicinal plant

L. M. Rifnas [1*], N. P. Vidanapathirana[1], T. D. Silva[2], N. Dahanayake[3], S. S. Weerasinghe[1] and S. Subasinghe[1]

[1]*Department of Agro Technology, Institute for Agro technology and Rural Sciences, Weligatta,Sri Lanka.*
[2]*Department of Plant Science, Faculty of Science, University of Colombo, Sri Lanka.*
[3] *Department of Agricultural Biology, Faculty of Agriculture, University of Ruhuna, Sri Lanka.*
*Email : rifnaslm@yahoo.com

Received : 19.11.2019 ; Revised : 28.12.2019 ; Accepted: 31.12.2019

ABSTRACT

Changes in the genetic structure of the plant can produce physiologically and chemically efficient plant types with increased production of secondary metabolites. Mutation is a sudden change in the gene which leads to genetic variations. Gamma radiation is a mutagenic agent used extensively to create variations. An experiment was conducted at the University of Colombo Institute for Agro Technology and Rural Sciences, Weligatta with the objective of determining the effective dose of gamma radiation to induce mutations on *A. cathartica*. Rooted plants were exposed to gamma radiation using "Gamma chamber 1200 Cobalt-60" research irradiator and these treatments were carried out at Horticultural Crop Research and Developmental Institute, Gannoruwa. Treatments applied were 0Gy (control), 30Gy, 60Gy, 90Gy, 120Gy and 150Gy. Treated plants were arranged under shade house condition in Complete Randomized Design with three replications and each replication contained eight plants. Survival rate of the plants were recorded continuously up to four weeks at five days intervals. The mutagenic treatments were tested for lethal dose of 50% and the dose at which 50% of the survival at one month was considered as LD50 values. Data were analyzed using ANOVA in SAS software and treatment means were compared using DMRT. It was found that there were significant ($p>0.05$) difference among the gamma radiation treatments on survival rate of the *Allamanda cathartica* plants. Highest survival rate was found in control treatment and decreased the survival rate with increasing doses of radiations. *A. cathartica* plants showed 50% survival at 90 Gy. It could be concluded that the radiation below 90 Gy should be imposed to induce mutations in *Allamanda cathartica*.

Keywords : *Allamanda cathartica*, gamma radiation, mutation, survival.

INTRODUCTION

Allamanda is a genus of flowering plants in the family, Apocynaceae is widely distributed and an indigenous plant in Sri Lanka. *Allamanda* species are familiar as ornamental plants cultivated for their large, yellow and pink colorful flowers and make attractive to the environmental beautification (De Souza-Silva and Rapini, 2009) and it is easily propagated using semi-hardwood cuttings (Hartmann *et al.*, 2010). It has already been reported that many ornamental plants have higher therapeutic and medicinal values (Rajvanshi and Dwivedi, 2017). *Allamanda cathartica* commonly called as Rukkathana, has various medicinal and ornamental values. This plant is used in ayurvedic and unani system for the treatment of various illnesses due to its bioactive secondary metabolites. For medicinal purpose, the milky sap of *Allamanda* possesses antibacterial and possible anticancer properties. Besides, the leave, roots and flowers have been used in the preparation of a powerful cathartic that helps in bowel movement. It also has the possibility as anti-dermatophytic agent and has effects on gastrointestinal motility (Kampanilya, 2013). The use of induced mutations has played a key role in the improvement of superior plant varieties (Ahloowalia and Maluszynski, 2001; Maluszynski *et al.*, 2004; Jain, 2005). Gamma rays are known to influence plant growth and development by inducing cytological, genetical, biochemical, physiological and morphogenetic changes in cells and tissues (Jan *et al.*, 2010). Hence, considering this, an experiment was conducted with the objective of increasing genetic variation in *Allamanda cathartica* plants and to assess the efficiency of different mutagenic treatments, since basic information on this aspects are limited. The first step was to estimate the LD50

value of gamma radiation dose for survival of the *Allamanda cathartica*. LD 50 value provides a good test of the sensitivity of the material to the mutagenic treatment.

MATERIALS AND METHODS

This experiment was conducted at the University of Colombo Institute for Agro-technology and Rural Sciences, Weligatta, Hambantota, Sri Lanka. Semi hardwood stem cuttings of *Allamanda cathartica* were collected from the mother plant with two years of age in Weligatta area and used for this study. Stem cuttings were dipped in water contained bucket soon after detaching from the plant to avoid wilting. Cuttings containing three nodes were used for the planting. A slant cut was made at the distal end of the cutting using a sharp blade and the cut surface was dipped in a root hormone "ROOCTA" (a.i.: Indole 3 – Butyric Acid, Distributed by Oasis Marketing (Pvt) Ltd).

Black polyethylene pots with diameter of 2 inches and with height of 2 inches were filled with the media contained sand and coir dust in equal parts of volume. Cuttings were planted in prepared pots and maintained inside a propagator for one month of time. Rooted and sprouted plants were hardened for one week of time under the shade condition by gradually exposing the rooted plants to the sun.

Figure 1 : Semi hardwood stem cutting used for propagation

Figure 2 : Hardened plants for the gamma radiation

Healthy plants were selected and exposed to gamma radiation treatments using Gamma chamber 1200 Cobalt-60 research irradiator and these treatments were carried out at the Horticultural Crop Research and Developmental Institute, Gannoruwa, Sri Lanka. The treatments were 0 Gy (control), 30 Gy, 60 Gy, 90 Gy, 120 Gy and 150 Gy. Treated plants were arranged in Complete Randomized Design in a shade house with three replications and each replication contained eight plants. Those plants were maintained under a shade house condition with optimum management practices such as regular watering, application of fertilizers and pesticides.

Survival rate of the plant was recorded continuously for one month at five days intervals. The mutagenic treatments were tested for lethal dose of 50% and the dose at which 50% of the survival at one month after gamma radiation treatment was considered as LD50 values. Collected data were analyzed using ANOVA in SAS software and treatment means were compared using DMRT.

RESULTS AND DISCUSSION

It was found that there was significant ($p<0.05$) differences between the gamma radiation treatments on survival rate of *Allamanda cathartica* plants (Table 1).

The highest survival rate was observed in the control where the treatment received no any gamma radiation doses. Increasing of gamma radiation reduced the survival rate of plants. Lowest survival rate was observed in the treatment received 150 Gy. In the first few days of the treatments plants died very slowly exhibiting a fairly good survival rate. However, with time the survival rate was decreased drastically. This could be due to the damage in plant tissue and breakdown of meristematic cells with time (Tien *et al*., 2000; Kovacs and Keresztes, 2002).

Figure 3 : Dying plants after the gamma radiation treatment

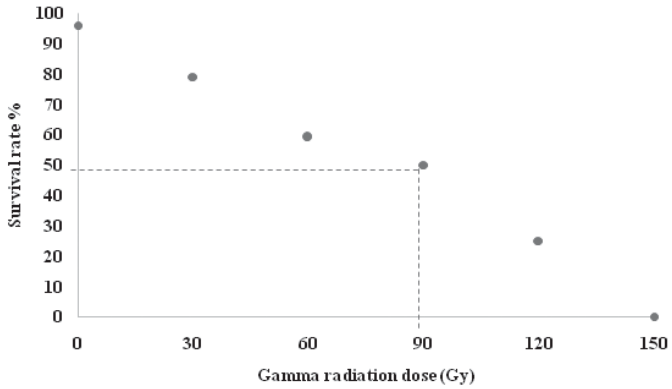

Figure 4 :Effect of gamma radiation on survival rate of *Allamanda cathartica* at 30th day after treatment

Table 1 : Effects of gamma radiation on survival rate (%) of *Allamanda cathartica*

Treatments	5th day	10th day	15th day	20th day	25th day	30th day
T1 (0 Gy)	96^{a}	96^{a}	96^{a}	96^{a}	96^{a}	96^{a}
T2 (30 Gy)	92^{ab}	88^{ab}	79^{b}	79^{a}	79^{b}	79^{b}
T3 (60 Gy)	88^{ab}	79^{b}	71^{b}	59^{b}	59^{c}	59^{c}
T4 (90 Gy)	84^{bc}	75^{b}	67^{b}	54^{bc}	54^{c}	50^{c}
T5 (120 Gy)	75^{cd}	54^{c}	46^{c}	42^{bc}	29^{d}	25^{d}
T6 (150 Gy)	71^{d}	59^{c}	42^{c}	38^{c}	0^{e}	0^{e}
Pr> f	0.0012	0.0002	<0.0001	<0.0001	<0.0001	<0.0001

Means followed by the same superscripts are not significantly different at p>0.05

LD50 value was calculated on the basis of 50 percent reduction of survival rate on 30thday after gamma radiation treatment. The present investigation exhibited that the survival rate of *Allamanda cathartica* decreased with the increase in the dose of the mutagens (Figure 4). About 50% of survival rate at 30th day after treatment was observed in the treatment where 90 Gy of gamma radiation dose was received. These reduction on survival rate of the plant was similar to those of in *Canscoradecurrens*, which is a medicinal plant used in the formulations used to improve intelligence, memory and other higher mental function when different doses of gamma radiations were imposed (Yadav,2016).

Low dose (10-15 Gy) of gamma ray was most positively effective on subsequent growth of plant (Shakhs *et al.,* 2007; Smelkova, 1999) and the radiation is a potential hazard because it can damage DNA and impair physiological processes leading to cytotoxic effects. (Taguchi and Kojima, 2005; Yadav and Kogje, 2015). As indicated by El-Khateeb*et al*. (2016) when *Philodendron scandens* (a plant having ornamental value) were exposed to different doses of gamma radiation decreased the survival rate, which gradually decreased as the gamma dosage increased. The effect of gamma rays on plant survival was gradual depending on the exposure dose, irrespective of the irradiation method (Sawangmee *et al.,* 2011).

ACKNOWLEDGEMENT

This research was supported by the Accelerating Higher Education Expansion and Development (AHEAD) Operation of the Ministry of Higher Education funded by the World Bank.

REFERENCES :

Ahloowalia B and Maluszynski M. 2001. Induced mutations - a new paradigm in plant breeding. *Euphytica*, **118**:167–173.

De Souza-Silva RFand Rapini A. 2009. *Allamanda calcicola* (Apocynaceae), an overlooked new species from limestone outcrops in the States of Minas Gerais and Bahia, Brazil. *Kew Bulletin*, **64**(1):171-174.

El-Khateeb MA, Abdel-Ati KEA and Khalifa MAS. 2016. Effect of gamma irradiation on growth characteristics, morphological variations, pigments and molecular aspects of *Philodendron scandens* plant. *Middle East Journal of Agriculture Research*, **5**(01),:6 13.

Hartmann HT, Kester DE, Davies FT and Geneve RL. 2010. Propagation of Ornamental trees, shrubs, and woody vines. Plant Propagation: Principles and Practices, 6th edition, Prentince Hall, New Jersey, pp.701-702.

Jain SM. 2005. Major mutation-assisted plant breeding programmes supported by FAO/ IAEA. *Plant Cell Tissue Organ Cult.,* **82**:113–121.

Jan S, Parween T, Siddiqi TO and Mahmooduzzafar. 2010. Gamma radiation effects on growth and yield attributes of *Psoraleacorylifolia* L. with reference to enhanced production of psoralen. *Plant Growth Regulation*, **64**:163-171.

Kampanilya 2013. Philippine medicinal plants. Retrieved on : http://www.stuartxchange.org/ Kampanilya.html.

Kovacs E and Keresztes A. 2002. Effect of gamma and UV-B/C Radiation on plant cell. *Micron.*, **33:** 19- 210.

Maluszynski M, Szarejko I andMaluszynska J. 2004. Mutation techniques. *Encycl Appl Plant Sci.* 1–3:186–201

Rajvanshi SK and Dwivedi DH. 2017. Screening of secondary phytometabolite of hydro-distilled essential oil from fresh flower and leaves of African marigold (*Tageteserecta* L.). *International Journal of Minor Fruits, Medicinal and Aromatic Plants,* **3**(2):1-7.

Smelkova L. 1999. Effect of gamma rays on the germination of conifer seeds. *Acta. Facultatis. Forestalis, Zvolen, Slovakia,* **41**:81-90.

Taguchi M and Kojima T. 2005. Yield of OH radicals in water under high-density energy deposition by heavy-ion irradiation. *Radiatant Res*., **163**:455-461.

Tien TN, Ha VT, Nu NT, Han TT, Nhan ND and Dien DT. 2000. Induction of flower mutations in (*Chrysanthemum morifolium* Ramat.) by jointly using in vitro culture technique and ionizing radiation. Hanoi, pp. 82-89.

Yadav VK. and Kogje KK. 2015. Microsporogenesis, structure and viability of pollen in *Canscoradecurrens* Dalzell a potent medicinal plant. *International Journal of Herbal Medicine*, **3**(1):01-04.

Yadav V. 2016. Effect of gamma radiation on various growth parameters and biomass of *Canscoradecurrens* Dalz. *International Journal of Herbal Medicine*, **4(**5): 109-115.