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Effect of gamma irradiation on chlorophyll content in M_1V_1 and M_1V_2 generation of *J. auriculatum* cv. CO 1 Mullai

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Abstract
The experiment was carried out to investigate the mutagenic effects of gamma radiation on chlorophyll concentration in the J. auriculatum physiological stages of flowering. The LD_{50} (50 percent lethality) was attained at 20 Gy. Three doasges 15, 20 and 25 Gy of gamma rays were subjected. The cuttings were planted to raise the M_1V_1 generation. The M_1V_1 generation cuttings were collected and planted in the next season to raise the M_1V_2 generation. Leaf chlorophyll content was measured for M_1V_1 and M_1V_2 generation plants. Flowering stage mean ranged from 54.52 (control) and 55.25 (best treatment). The decrease in chlorophyll is observed when increase gamma irradiation in both M_1V_1 and M_1V_2.

Keywords: *J. auriculatum*, chlorophyll content, gamma irradiation, flowering

1. Introduction
Jasminum auriculatum is a traditional flower that is used as a border or pot plant. It's also found in scented/aromatherapy gardens. The average yield of CO 1 Mullai is 11.1t/ha. Tami Nadu's Mullai productivity tends to lag the national average. Because there are no superior cultivars for planting, farmers rely mostly on landraces to cultivate jasmine. *Jasminum auriculatum* has few variations within its species, and improved variants are rare. As a result, *J. auriculatum* must be developed to boost the high yield through a breeding programme that increases genetic variation. Hence, crop genetic improvement is essential to enhancing the yield of this highly valued ornamental crop. Brock (1979) [1] stated that using mutagens or other artificial methods, it is possible to increase this rate by a thousandfold. Plants that are vegetatively propagated are an excellent material for mutant breeding. Gamma rays can generate more changes than any other type of radiation and have been discovered to be effective for inducing chlorophyll alterations.
Chlorophyll mutations and morphological modifications are two examples of changes observed following mutagenesis (Patil and Rane, 2015) [4]. Crop plant improvement is largely dependent on genetic heterogeneity within the species. Over time, man has relied on naturally occurring variants caused by mutation to improve crop productivity and quality. Chlorophyll development depends under the control of several genes, which are located on different chromosomes (Swaminathan *et al.*, 1962) [2]. Gamma rays and EMS may produce nuclear gene alterations or chromosomal abnormalities, resulting in chlorophyll-deficient mutants.
The purpose of the study is to evaluate putative mutants of *J. auriculatum* generated through physical and chemical mutation with various dosages of gamma radiation at M_1V_1 and M_1V_2 generation.

2. Materials and Methods
The present research work on mutation breeding in *Jasmine auriculatum* was carried out at the Department of Floriculture and Landscaping, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore (Latitude of 11000'N, Longitude of 77000'E and an elevation of 412 m above MSL), Tamil Nadu during February 2020 to May 2022.
The experiment was carried out at Department of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during 2019 to 2022. CO1 Mullai a variety released by TNAU (1972), Coimbatore which is a genotype based on region, popularly cultivated in the southern districts of Tamil Nadu was used in this study. Pencil thickness semi-hard wood cuttings (13-15 cm long with four pairs of nodes) of the variety Mullai CO.1 were irradiated with 15, 20 and 25 Gy of gamma rays at the dose rate of 5000 rad

per minute in Gamma chamber - 1200 available at Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore.

And total of 30 plants survived after the pot culture, were transferred to the field, and planted at the spacing of 2x1.5m in February 2020 and M_1V_2 was raised from the best isolated mutants. Out of the survived plants high yield plants of P4, P6 and P14 was recorded the best yield paraments in both M_1V_1 and M_1V_2 population. Hence a comparison to control plants, the mutagenized M_1V_1 and M_1V_2 population was screened for chlorophyll content during flowering season in 2019-2020

3. Chlorophyll content (mg g^{-1} FW)

Irradiation has a direct effect on the amount of chlorophyll in leaves (Alikamanoglu *et al.*, 2011) [5]. The photosynthetic efficiency is represented by chlorophyll content. Furthermore, total chlorophyll content differs between chlorophyll mutants and controls. As a result, total chlorophyll was measured using a SPAD 502 chlorophyll metre on the fully grown fourth leaf from the shoot's tip in this investigation. The concentration of chlorophyll a, chlorophyll b, and total chlorophyll in the leaves was measured using the method of (Yoshida *et al.*, 1971) [3] and expressed in mg g^{-1} of fresh weight.

$$\text{Chlorophyll}_a = 12.7 \times (A_{663}) + 2.69 \times (A_{645}) \times \frac{V}{1000 \times W}$$

$$\text{Chlorophyll}_b = 22.9 \times (A_{645}) + 4.68 \times (A_{663}) \times \frac{V}{1000 \times W}$$

$$\text{Total chlorophyll} = 20.2 \times (A_{645}) + 8.02 \times (A_{663}) \times \frac{V}{1000 \times W}$$

Where,

A = Absorbance at specific wavelength (nm)
V = Final volume of chlorophyll extract (ml)
W = Fresh weight of tissue extracted (g)

4. Results and Discussion

Mutation has been shown to affect a variety of physiological systems in plants. The chlorophyll a, b, and total chlorophyll content of selected putative mutants developed in this study showed an uneven distribution of chlorophyll content between treated and untreated control plants. This conclusion is consistent with a previous discovery in pigeon pea (Desai and Rao, 2014) [6] according to this, low levels of gamma irradiation have little effect on chlorophyll.

In M_1V_1 generation the chlorophyll content was higher in P4 - M_1V_1 (15 Gy) recorded higher chlorophyll a (1.17), chlorophyll b (0.41) total chlorophyll of (1.57) and SPAD value of 55.25 in comparison to control chlorophyll a (1.08), chlorophyll b (0.28), total chlorophyll (1.41) and SPAD value of 54.52. The chlorophyll content seemingly decreases with increases in dosage on the survived population in P6 - M_1V_1 (20 Gy), P14 - M_1V_1 (25 Gy) dosage.

Whereas in M_1V_2 generation P4 - M_1V_2 (15 Gy) recorded slightly higher amount of chlorophyll a (1.20), chlorophyll b (0.42) total chlorophyll and SPAD value (60.98) of (1.60) in comparison to control chlorophyll a (1.13), chlorophyll b (0.23), total chlorophyll (1.39) and SPAD value (56.52). The chlorophyll content decreased with in dosage on the survived population in P6 - M_1V_2 (20 Gy), P14 - M_1V_2 (25 Gy) dosage.

And comparing level of dosages, increase in dosage leads to decease in chlorophyll content whereas slight increase in the level of chlorophyll while passing after to the2 nd generation.

The photosynthetic capabilities of the irradiated *J. auriculatum* plants improved when the dose was low, but when the dose was high, the photosynthetic pigments were destroyed, reducing the photosynthetic capacities of the M_1V_1 and M_1V_2 gamma irradiated Jasmine plants. This could possibly be related to the treatments reducing the regular pattern of grana and stroma in the thylakoids (Alihamonghu *et. al.*, 2011). From pre-flowering until blossoming, the chlorophyll level increased and then decreased as the zygote formation and development, the flowering stage necessitates a high chlorophyll level (Azigwe S *et al.*, 2020) [7].

Table 1: Effect of mutagens on chlorophyll content in M_1V_1 generation of *J. auriculatum* cv. CO 1 Mullai during 2019

Treatments	Chlorophyll-a	Chlorophyll-b	Total chlorophyll	SPAD value
Control	1.08	0.28	1.41	54.52
P4 - M_1V_1 (15 Gy)	1.17	0.41	1.57	55.25
P6 - M_1V_1 (20 Gy)	1.13	0.31	1.43	53.63
P14 - M_1V_1 (25 Gy)	1.12	0.21	1.34	52.47

Table 2: Effect of mutagens on chlorophyll content in M_1V_2 generation of *J. auriculatum* cv. CO 1 Mullai during 2020

Treatments	Chlorophyll-a	Chlorophyll-b	Total chlorophyll	SPAD value
Control	1.13	0.23	1.39	56.52
P4- M_1V_2 (15 Gy)	1.20	0.42	1.60	60.98
P6- M_1V_2 (20 Gy)	1.19	0.32	1.46	62.78
P14- M_1V_2 (25 Gy)	1.14	0.34	1.50	58.46

5. Conclusion

For CO.1 Mullai, the total number of isolated putative mutants discovered was 3 in gamma irradiated in M_1V_1 and M_1V_2, respectively, which can be further propagated and assessed in later generations for stability and horticultural importance of the changes.

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