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Evaluation of field performance of mutant lines M_1V_1 and M_1V_2 of *Jasminum auriculatum* cv. CO 1 Mullai

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Abstract
Jasminum auriculatum is flower crop widely cultivated as loose flower. The crop has slight difficulty improvement as it has narrow genetic variability hence induction of mutagenesis through gamma rays and EMS application has been adopted to create variability in jasmine. Therefore, the objective to evaluate the putative mutants of *J. auriculatum* generated through physical and chemical mutation with various dosages of gamma radiation and EMS at M_1V_1 and M_1V_2 generation. The cuttings were irradiated with 10, 15, 20 and 25 Gy of gamma rays and with EMS (25, 30, 35 and 40 mM) for M_1V_1 generation and individual plant parameter were observed in both M_1V_1 and M_1V_2 generation. Data were collected on plant height (cm), number of primary branches (cm), internodal length (cm), number of leaves, leaf area (cm^2), days of flowering, flower bud length (cm), corolla tube length (cm). High doses of gamma radiation lower germination and survival percentages, according to field observations of M_1V_1 generation. The LD_{50} (50 percent lethality) was attained at 20 Gy and 40 mM. The morphological parameters were all affected with increase in dosage with gamma rays and EMS. The plant height and internode length seemingly decrease with increase in the dosage. Whereas M_1V_2 generation the survival rate differed depending on the x-ray irradiation dosage, as well as the uneven establishment count after planting were observed. Persistent physiological damage transferred from M_1V_1 and M_1V_2 generation caused the survival rate to drop. Observation on growth and flowering character showed positive effect on the flower bud length (3.10 cm), corolla tube length (2.42 cm) and the number days to flowering was higher M_1V_2 generation. The mutant's morphological differences from the parental plant (control) indicated that new genetic diversity had emerged in the irradiated *J. auriculatum*.

Keywords: *J. auriculatum*, gamma rays, EMS, Mutants, Irradiation

Introduction
Jasminum auriculatum is traditional flower used as ornamental plants, as border and pot plants. It is also used in fragrant/aromatherapy garden. CO 1 Mullai has an average yield of 11.1t/ha. Mullai productivity in Tami Nadu is still relatively lower than the national productivity. Farmers rely primarily on landraces to cultivate jasmine because there are no superior types for planting. *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) [3] stated that using mutagens or other artificial methods, it is possible to increase this rate by a thousand fold. Plants that are vegetatively propagated are an excellent material for mutant breeding. It primarily eliminates two important constrains like high degree of heterozygosity and frequent polyploidy. Another essential component of this breeding approach is the improvement of qualitative and quantitative traits, including tolerance to biotic and abiotic stressors (Kwon and Im, 1973) [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.
Induced mutation has pave way to extraordinary achievements in crop improvement. Plant characters such as plant height, number of leaves, number of primary branches, number of flowers/cymes have been obtained through induction of mutagenic agents like physical mutagen like gamma rays and chemical mutagen like EMS (Iwo *et al.* 2013) [5] and Simmond 1979). It allows for the induction of desired characteristics that are either not exhibited in nature or have been lost during evolution. Mutation induced by physical or chemical mutagens is a feasible method for varietal development in vegetatively propagated plants. Therefore, induced mutation helps in *J. auriculatum* using gamma rays and EMS.

The purpose of the study is to evaluate the putative mutants of *J. auriculatum* generated through physical and chemical mutation with various dosages of gamma radiation and EMS at M_1V_1 and M_1V_2 generation.

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 10, 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. Another set of cuttings was also treated with EMS (25, 30, 35 and 40 mM) and total of 56 plants survived after the pot culture, were transferred to the field, and planted at the spacing of 2x1.5m in February 2020. In comparison to control plants, the mutagenized M_1V_1 population was screened for deviation in several features such as vegetative development and flowering parameters.

The M_1V_1 generation plants of *J. auriculatum* cv. CO1 Mullai were further raised for the next vegetative generation namely, M_1V_2 through vegetative propagation using
semi -hardwood cuttings and placed under poly-tunnels with average temperature of 28-30 °C and relative humidity 80% to induce rooting. The M_1V_2 putative mutants were moved to grow-bags filled with potting mixture after root development and assessed for several growth characteristics. In M_1V_2 generation, five putative mutants which expressed distinct mutations in the plant growth, flower yield.

Results and Discussion

In M_1V_1 of Jasmine plants, the sprouting and survival rates of cuttings decreased when the dosage of gamma rays and EMS was increased. At greater mutagen doses, plant height, internodal length, number of sprouts per plant, leaf length, and leaf width all reduced. The highest mutagen doses in each cultivar resulted in the most leaf abnormalities. The flowering season observed to begin from April and peaks in May and July and gradually decreases in August and ends in September (2020-2021). Among the five mutated plants such P4 (15Gy), P6 (20Gy), P14 (25Gy), P17 (35mM), P30 (mM) were found to be the high yielding putative mutant from M_1V_1 and (Table 1).

Vegetative Parameters of M_1V_1 and M_1V_2

In the evaluation of M_1V_1 generation done for *J. auriculatum* cv. CO.1 Mullai where the data revealed that plant height was found to be higher in P4 - M_1V_1 (15 Gy) 57.3 cm compared to control (35.31 cm) and internodal length decreased with increase in dosage while in lower dosage and it recorded higher in P4 - M_1V_1 (15 Gy) 4.6 cm and recorded the lowest in control (3.9 cm). The number of primary branches were higher in P4 - M_1V_1 (15 Gy) 3.11 and followed by P6- M_1V_1 (20Gy) 4.5. The number of leaves seemingly increased while comparing to the control were recorded higher in P4- M_1V_1 (15 Gy) of 75.79 and leaf area was recorded higher in P6- M_1V_1 (20Gy) 7.31 cm^2.

In the evaluation of M_1V_2 generation the data revealed that plant height was found to be higher in P17 - M_1V_2 (35 mM) 44.19 cm compared to control (37.31 cm) and internodal length increased with increase in dosage in M_1V_2 generation while in higher dosage the internode length was recorded higher in P4 - M_1V_2 (35 mM) 4.68 cm and recorded the lowest in control (3.78 cm). The number of primary branches were higher in P17 - M_1V_2 (35 mM) 3.40 and followed by P30-M_1V_2 (40 mM) 4.5. The number of leaves seemingly increased while comparing to the control were recorded higher in P17- M_1V_2 (35 mM) of 51.77 and leaf area was recorded higher in P6- M_1V_1 (35 mM) 8.51 cm^2 (Table 1 and 2). (Ukai and Yamashita, 1980) attributed the growth reduction to cumulative expression of mitotic cycle delay, development of chromosomal structural abnormalities, and loss of early differentiation or cell death hence when the dosage of mutagens was increased, the plant height and internode length decreased. Low dosages of gamma rays and EMS may stimulate cell division and elongation or modify metabolic pathways that affect phytohormone or nucleic acid synthesis (Chandrashekar, 2014) [8].

Flowering Parameters of M_1V_1 and M_1V_2

The days of flowering was earlier as 149.22 in P6 - M_1V_1 (20 Gy) which recorded the early flowering in the isolated mutants. The flower bud lengths were recorded higher in P17- M_1V_1 (35mM) 2.89 cm followed by P30 - M_1V_1 (40mM) 2.71 cm compared to control 1.99 cm and the corolla tube length were found higher in P17 - M_1V_1 2.21cm and followed by 2.03 cm in P30 - M_1V_1 (40mM) 2.03 compared to control (1.31 cm).

In M_1V_2 the days of flowering was earlier as 133.21 in P4 - M_1V_2 (15 Gy) and P17- M_1V_2 (35mM) 133.62 which recorded the early flowering in the isolated mutants. The flower bud lengths were recorded higher in P17- M_1V_2 (35mM) 3.10 cm followed by P30 - M_1V_1 (40mM) 3.00 cm compared to control 2.21 cm and the corolla tube length were found higher in P17 - M_1V_2 (35 mM) 2.42cm and followed by 2.32 cm in P30 - M_1V_2 (40mM) compared to control (1.53 cm) (Table 1 and 2).

The days to flowering were later in M_1V_2, even though earliness in flowering were registered in control and M_1V_1 generation. In this study it is observed that at higher doses of gamma rays and EMS, flowering parameters indicated a favourable reaction, however very high doses had a negative impact on the parameters. In comparison to the control, lesser doses of mutagen treatments accelerated blooming and increased flower output. Low and intermediate quantities of mutagens are known to accelerate cell proliferation and, in certain situations, result in faster flowering (Funk *et al*, 1995).

Mean performance of flowering traits in M1V1 generation

A month wise flower yield (g/plant) of mutagen treated plants of *J. auriculatum* cv.CO.1 Mullai in M_1V_1 generation of 56 treated plants was observed between 2020-2021. And it is reported that, the plants showed highest in the May 2021. P16

M_1V_1 recorded 245.61g/plant in the month of May. In this study, an increase in the number of flowering cymes/branches was seen in all genotypes at lower gamma ray doses and higher EMS doses. Increased flowering cymes and, as a result, the production of more flower buds per plant resulted in a higher yield at lower dosages. According to (Khangyldin, 1967) [9], gamma irradiation increased the formation of leaves, shoots, and flower buds by increasing the kinetin to auxin ratio (Table 3).

Table 1: Vegetative and flowering characters of mutagen treated plants of *J. auriculatum* cv. CO 1 Mullai in M_1V_1 generation (8th month)

Vegetative characters						Flowering characters		
Progeny of putative mutants	**Plant height (cm)**	**Number of primary branches (cm)**	**Internodal length (cm)**	**Number of leaves**	**Leaf area (cm^2)**	**Days of flowering**	**Flower bud length (cm)**	**Corolla tube length (cm)**
Control	35.31	2	3.9	70.41	7.8	145.00	1.99	1.31
P4- M_1V_2 (15 Gy)	57.3	3.11	4.6	75.79	7.31	133.21	2.41	1.72
P6- M_1V_2 (20 Gy)	50.53	2.59	4.2	69.15	8.12	137.99	2.58	1.90
P14- M_1V_2 (25 Gy)	48.62	2.38	4.3	72.41	6.03	142.57	2.65	1.97
P17- M_1V_2 (35mM)	59.11	2.16	4.4	71.60	8.21	133.62	2.89	2.21
P30- M_1V_2 (40mM)	57.53	2.02	4.5	70.35	7.07	142.18	2.71	2.03

Table 2: Vegetative and flowering characters of mutagen treated plants of *J. auriculatum* cv. CO 1 Mullai in M_1V_2 generation (8th month)

Vegetative characters						Flowering characters		
Progeny of putative mutants	**Plant height (cm)**	**Number of primary branches (cm)**	**Internodal length (cm)**	**Number of leaves**	**Leaf area (cm^2)**	**Days of flowering**	**Flower bud length (cm)**	**Corolla tube length (cm)**
Control	47.31	3.13	3.78	49.7	7.92	171.32	2.21	1.53
P4- M_1V_2 (15 Gy)	42.37	2.15	3.67	50.09	8.37	155.10	2.80	2.12
P6- M_1V_2 (20 Gy)	39.53	3.11	3.15	48.78	7.64	149.22	2.83	2.15
P14- M_1V_2 (25 Gy)	30.61	2.20	1.99	47.03	7.81	158.11	2.9	2.22
P17- M_1V_2 (35mM)	44.19	3.40	4.68	51.77	8.51	159.66	3.10	2.42
P30- M_1V_2 (40mM)	41.58	3.22	4.33	48.41	8.41	160.01	3.00	2.32

Table 3: Month-wise flower yield (g/plant) of mutagen treated plants of *J. auriculatum* cv.CO.1 Mullai in M_1V_1 generation (2020-2021)

Treatments	Jun-20	Jul-20	Aug-20	Sep-20	Apr-21	May-21
CO1	107.45	112.83	77.33	2.42	109.75	128.13
P1	127.00	131.54	96.04	21.13	129.30	146.84
P2	126.44	132.15	96.65	21.74	128.74	147.45
P3	102.28	107.07	71.57	-3.34	104.58	122.37
P4	139.38	144.97	109.47	34.56	141.68	160.27
P5	121.53	126.89	91.39	16.48	123.83	142.19
P6	172.54	177.83	142.33	67.42	174.84	193.13
P7	123.46	129.49	93.99	19.08	125.76	144.79
P8	121.42	126.42	90.92	16.01	123.72	141.72
P9	143.56	149.61	114.11	39.20	145.86	164.91
P10	179.35	184.20	148.70	73.79	181.65	199.50
P11	120.46	126.17	90.67	15.76	122.76	141.47
P12	126.88	131.86	96.36	21.45	129.18	147.16
P13	110.32	116.29	80.79	5.88	112.62	131.59
P14	223.95	230.31	194.81	119.90	226.25	245.61
P15	101.97	107.45	71.95	-	104.27	122.75
P16	98.96	104.25	68.75	-	101.26	119.55
P17	128.76	134.10	98.60	23.69	131.06	149.40
P18	117.25	123.06	87.56	12.65	119.55	138.36
P19	95.76	100.20	64.70	-	98.06	115.50
P20	123.46	128.88	93.38	18.47	125.76	144.18
P21	186.49	192.14	156.64	81.73	188.79	207.44
P22	141.99	146.40	110.90	35.99	144.29	161.70
P23	94.30	99.60	64.10	-	96.60	114.90
P24	127.86	134.10	98.60	23.69	130.16	149.40
P25	101.44	107.30	71.80	-	103.74	122.60
P26	127.46	132.36	96.86	21.95	129.76	147.66
P27	89.51	95.20	59.70	-	91.81	110.50
P28	68.06	73.98	38.48	0.00	70.36	89.28
P29	136.13	141.24	105.74	30.83	138.43	156.54
P30	97.49	103.10	67.60	-	99.79	118.40
P31	98.62	104.65	69.15	-	100.92	119.95
P32	122.66	128.10	92.60	17.69	124.96	143.40

P33	173.02	179.66	144.16	69.25	175.32	194.96
P34	152.50	157.81	122.31	47.40	154.80	173.11
P35	101.41	107.10	71.60	-	103.71	122.40
P36	118.47	123.42	87.92	13.01	120.77	138.72
P37	94.09	99.40	63.90	-	96.39	114.70
P38	72.41	77.46	41.96	-	74.71	92.76
P39	117.48	123.96	88.46	13.55	119.78	139.26
P40	119.96	125.20	89.70	14.79	122.26	140.50
P41	94.36	99.95	64.45	-	96.66	115.25
P42	126.36	132.30	96.80	21.89	128.66	147.60
P43	175.06	180.38	144.88	69.97	177.36	195.68
P44	151.13	156.20	120.70	45.79	153.43	171.50
P45	89.73	95.40	59.90	-	92.03	110.70
P46	141.72	146.94	111.44	36.53	144.02	162.24
P47	146.94	153.72	118.22	43.31	149.24	169.02
P48	188.39	193.93	158.43	83.52	190.69	209.23
P50	93.30	99.10	63.60	-	95.60	114.40
P51	82.15	88.06	52.56	-	84.45	103.36
P52	128.00	133.44	97.94	23.03	130.30	148.74
P53	104.03	109.90	74.40	-	106.33	125.20
P54	105.18	109.55	74.05	-	107.48	124.85
P55	121.58	125.94	90.44	15.53	123.88	141.24
P56	107.62	113.00	77.50	2.59	109.92	128.30

Conclusion

For CO.1 Mullai, the total number of putative mutants discovered was 5, respectively, which can be propagated and assessed in later generations for stability and horticultural importance of the changes.

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