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Research Article

Effect of chemical mutagen (Ethyl methane sulfonate) on Money plant (*Epipremnum aureum)*

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Abstract
Epipremnum aureum, commonly known as pothos, is a hardy indoor foliage ornamental crop. Mutation breeding in Golden pothos is needed to meet the demand for more valuable and highly sought-after cultivars. The present study aimed to exploit variability on various parameters *viz.* new leaf emergence, survival percentage, plant height, length and width of leaves. The experiment was set up using a Complete Randomized Design (CRD) with 8 treatments and 3 replications. Rooted cuttings of Golden pothos were treated with varying concentrations of Ethyl Methane Sulfonate (EMS) for 4 hours, and a control treatment was included. The results showed that all the treated cuttings with EMS delays the new leaf emergence period compared to the control. Compared to the control, the minimum number of new leaf emergences was found in EMS-treated plants. The maximum survival percentage (100%) was recorded in 0.1%, 0.5% and control treatment. The lowest plant height (15.3 cm) was observed in treatment T4 (1.5 % EMS) treated plants. However, maximum plant height was observed in the control treatment at 150 days of interval. In comparison to the control, EMS decreased the length and width of leaves at higher dosages. The minimum leaf length and width, i.e. 2.40 cm and 1.20 cm, were recorded in plants treated with EMS at 2%, while maximum length and width were observed in control and low EMS-treated plants. The study showed that ethyl methane sulfonate affected plant development characteristics and showed some dwarfness of money plants. This appears to be the first report of EMS treatment on pothos.

Keywords: Ethyl Methane Sulfonate (EMS), Mutation, Mutagenesis, Pothos, Dwarfness

INTRODUCTION

The Money plant (*Epipremnum aureum*) originates in New Guinea and Southeastern Asia (Griffiths, 1994). This species, a famous indoor plant in temperate regions, has also neutralized in tropical and sub-tropical forests. Money plant has many similar names, such as Golden pothos, Ceylon creeper, hunter's robe, ivy arum, house plant, silver vine, Solomon Islands ivy, marble queen, and taro vine. In addition to Philodendron and Spider Plant, Golden Pothos is one of the top three indoor plants that have been identified as best at removing formaldehyde, according to NASA/ALCA findings on the use of indoor plants for indoor air cleansing. Antibacterial, antitermite and antioxidant properties are also present in *E. aureum* (Srivastava *et al.,* 2011). *Epipremnum aureum* green wall can reduce CO_2 by 35% *(*Taemthong and Plitsiri, 2023).

Epipremnum pinnatum (L.) Engl. is also believed to possess significant anticancer properties (Lan *et al.,* 2007). They are one of the best living things that are soothing to the eyes. Keeping money plants in indoor areas has many benefits and beautifies the space. *E. aureum* is regarded as an ideal Feng Shui plant in China. It means that the plants that bring prosperity and fortune) since they cleanse the toxins in the air brought on by home cleaning products. By purifying the air and increasing oxygen input, it energizes the house. Additional to the fundamental photosynthesis that eliminates carbon dioxide and replaces the air with oxygen, plants may also detoxify poisons from the soil, air and water (Srivastava *et al.,* 2011). This plant also plays an important role in Nature-based nutrient removal technology from wastewaters (Yadav *et al.,* 2021).

Money plants are a favourite among indoor plants because of their beautiful leaves and simple maintenance

requirements. The plant is typically used as an indoor plant, and it can thrive in a container without any soil or even water for a long time if you keep the water changing (Rani et al., 2017). While many plants can be grown hydroponically, money plants can only exist on the naturally occurring salts in the water. They can survive without the addition of nutrients to the water. It thrives in strong, filtered light. However, discoloration of the leaves occurs in varying degrees of light. The ideal growing range for Pothos is between 21 to 32.2 ^{0}C. Growth is significantly slowed by minimum temperatures below 21 ^{0}C and maximum temperatures above 32.2 ^{0}C .

New varieties of ornamentals are always needed in industrialized and modern floriculture. A well-established technique for crop improvement is mutation breeding, which has a significant role in creating numerous new colour and shape-mutant in ornamental plants (Broertjes and Van Harten,1988). Physical mutagens like X-rays, gamma rays, and neutrons and chemical mutagens like sodium azide and ethyl methane sulphonate have been used to increase the genetic resources of plants. Induced mutagenesis by EMS is a powerful tool to identify and characterizing the gene function (Chen *et al.,* 2023). EMS is a typical alkylating chemical that has proven its effectiveness as a mutagen to cause genetic variation. As a result, it becomes a crucial tool for improving plant characteristics (Mostafa, 2011). Pothos plants do not flower in the greenhouse or interior environments; even in their natural habitats, flowering is frequently observed. As a result, there are no known pothos hybrids. Considering the commercial importance of this ornamental plant and the difficulty in their flowering and hybridization, the present study aimed to induce mutation for available pothos cultivars of *E. aureum*. Several different mutagens are available for inducing mutations. The chemical mutagen (EMS) was chosen for its efficacy and simplicity of use and applied to improving morphophysiological traits.

MATERIALS AND METHODS

The present research was conducted at Floriculture Laboratory and Research Farm, Department of Floriculture and Landscaping, College of Agriculture, Lovely Professional University, Punjab, India, in 2022-2023. Money plants (*E. aureum*) were bought from the local plant nursery at Phagwara, Punjab (India). Cuttings of 4- 5 cm long were treated with 0.1 % carbendazim solution for 15 mins and then planted in the polyhouse in growing media after quickly dipping the basal ends of cuttings in 500 ppm IBA for good rooting. The cuttings were ready in 30 days for application of EMS. The uniform size of rooted cuttings of variety; Golden Pothos' were treated with seven concentrations of EMS (0.1%, 0.5%, 1%, 1.5%, 2%, 2.5%, 3%) by immersing in the chemical solutions for 4 hours. In the control, distilled water was used to submerge the rooted cuttings. After the treatment, these cuttings were washed with running tap water for 20 minutes. The treated cuttings with untreated control were planted in growbags of 24 x 11 cm in size. All the standard cultural practices were followed during the research period. All collected data was statistically analysed by a completely randomized design with three replications. The new leaf emergence parameter was observed on the 30th day after transplanting. Survival percentage, plant height, leaf length, and leaf width were measured using a meter scale from the plant's basal end to the tip of the newest mature leaf at 30-day intervals until 150 days. All the qualities under investigation were subjected to an analysis of variance (ANOVA). Additionally, least significant difference (LSD) values at the 5% probability level were calculated.

RESULTS AND DISCUSSION

The present study showed that ethyl methane sulfonate affected plant development characteristics. There was significantly less possibility of survival at

Table 1. Effect of ethyl methane sulfonate on the survival percentage of *Epipremnum aureum*

Treatments	Survival Percentage (%)				
	30 Days	60 Days	90 Days	120 Days	150 Days
T1 (0.1%)	100 %	100 %	100 %	100 %	100 %
T2 (0.5%)	100 %	100 %	100 %	100 %	100 %
T3 (1%)	100 %	100 %	100 %	93.33 %	93.33 %
T4 (1.5%)	100 %	100 %	93.33 %	86.66 %	80 %
T5 (2%)	100 %	93.33 %	73.33 %	26.66 %	6.66 %
T6 (2.5%)	86.66 %	53.33 %	00 %	00 %	00 %
T7 (3%)	00 %	00 %	00 %	00 %	00 %
T8 (control)	100 %	100 %	100 %	100 %	100 %
CV	4.756	7.143	8.150	11.164	9.622
SEM	2.357	3.333	3.333	4.082	3.333
CD 5%	7.066	9.993	9.993	12.239	9.993
CD	9.735	13.768	13.768	16.863	13.768

higher doses of EMS-treated money plant cuttings than low dose and untreated cuttings. The results are presented in Table 1. Various mutagenesis treatments significantly affected morphological features related to plant survival. The maximum survival percentage, *i.e.* 100%, was recorded in untreated and low concentration, *i.e.* 0.1% and 0.5% EMS, treated cuttings at 150 days after treatment. However, minimum survival percentages *i.e.* 6.66 % and 0 %, were recorded in 2%, 2.5% and 3% EMS-treated cuttings at 150 days of interval. Mutation meddles with the basic genetic structure of the genotype material and the survival and growth of the plants under genetic controls and is affected by the different mutagenic doses. External environmental factors were also responsible for the normal growth and survival of the treated and non-treated plants (Laskar *et al.,* 2018). The severe decline in plant survival rate with EMS treatments might be due to some poisonous compound created by specific biochemical processes, which induce cell death and eventually plant death (D'Amato *et al.,* 1956) and (Gordon, 1957). Similar reports were also recorded by Dilta (2003) in *Chrysanthemum* and Misra and Bajpai (1983) in *Gladiolus* ornamental crop.

The days for new leaf emergence decrease as the EMS concentration increased (Table 2). High-dose EMS treated plants recorded a minimum number of leaves, which also decreased the emergence days of the new leaf. The maximum number of leaves (4.33) was recorded in EMS untreated plants, which was followed by treatment T1, which had a 0.1 % smaller dose than the EMS treated plants. However, the minimum number of leaves (0.33) was recorded in high dose EMS (4%) treated money plants. Smaller EMS doses (0.25%) accelerated sprouting, whereas greater doses of 1.0% delayed it in tuberose (Yadav 2018).

The *E. aureum* experimental results showed that the

Table 2. Effect of ethyl methane sulfonate on the new leaf emergence of *Epipremnum aureum* on the 30th day after transplanting

Treatments (EMS)	New leaf emergence after 30 days (No. of leaves)
T_1 (EMS 0.1%)	3.00
T_2 (EMS 0.5%)	2.33
T_3 (EMS 1%)	1.00
T_4 (EMS 1.5%)	0.66
T_5 (EMS 2%)	0.33
T_6 (EMS 2.5%)	1.66
T_7 (EMS 3%)	0.66
T_8 (control)	4.33
S.E(m)	60.609
S.E(d)	0.612
C.D	1.835
C.V(%)	2.529

Table 3: Effect of ethyl methane sulfonate on leaf length, leaf width (cm) and plant height (cm) of *Epipremnum aureum* at 30 days interval

Treatments	30 days (cm)		60 days (cm)		90 days (cm)		120 days (cm)		150 days (cm)		30 days (cm)	60 Days (cm)	90 Days (cm)	120 Days (cm)	150 days (cm)
	Leaf length	Leaf width	Leaf length	Leaf width	Leaf length	Leaf width	Leaf length	Leaf width	Leaf length	Leaf width	Plant height	Plant height	Plant Height	Plant height	Plant height
T1 (0.1%)	3.63	2.97	5.10	3.40	6.67	3.93	7.67	4.20	8.47	4.33	6.26	10.1	15.4	24.6	34.1
T2 (0.5%)	4.27	3.37	5.77	3.87	6.97	4.20	8.07	4.50	9.00	4.77	6	9.6	13.2	18.0	26.8
T3 (1%)	3.20	2.53	4.63	3.07	6.00	3.43	7.07	3.87	7.83	3.97	5.9	9.3	10.5	15.4	18.8
T4 (1.5%)	3.10	2.33	4.47	2.97	5.93	3.30	6.80	3.87	7.30	4.03	5.8	8.7	9.8	12.4	15.3
T5 (2%)	2.83	2.07	4.27	2.57	5.60	3.23	6.63	3.63	2.40	1.20	5.6	8.2	9.10	0	0
T6 (2.5%)	2.67	2.13	4.20	2.47	0.00	0.00	0.00	0.00	0.00	0.00	5.5	0	0	0	0
T7 (3%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
T8(Control)	3.43	2.37	4.93	2.80	6.57	3.43	7.40	3.90	8.37	4.10	6	9.7	12.73	20.5	28.86
CV	5.422	4.863	5.471	6.084	3.989	8.444	3.197	6.881	21.252	27.355	1.860	2.356	2.382	1.663	1.22
SEM	0.090	0.062	0.131	0.092	0.108	0.131	0.100	0.119	0.852	0.442	0.055	0.095	0.121	0.109	0.109
CD 5%	0.271	0.186	0.395	0.278	0.325	0.393	0.301	0.356	2.557	1.325	0.165	0.284	0.365	0.327	0.327
CD 1%	0.373	0.257	0.544	0.383	0.448	0.542	0.415	0.491	3.52	1.826	0.228	0.392	0.503	0.451	0.451

EMS treatment significantly affected leaf length, width, and plant height (Table 3). It showed that the EMS treatment of pothos cuttings considerably reduced the length and width of the leaf compared to the control at higher EMS dosages. Except for dead plants, the minimum leaf length (2.40 cm) and leaf width (1.20 cm) were recorded in 2.0 % of EMS-treated plants. However, the maximum leaf length (9.00cm) and width (4.77cm) were recorded in treatment 0.5% EMS-treated plants at 150-day intervals. At a concentration of 3%, EMS-treated plants died on the 30th day and 2.5% on the 90th day. The decrease in leaf length and width with increasing EMS dosage might be due to inactivation, reduced auxin content, or changes in auxin synthesis. Vaidya *et al.* (2016) and Kapadiya *et al.* (2014) also recorded similar findings on leaf length and width in *Chrysanthemum* species at 0.02% and 0.04% doses. Moreover, the minimum plant height (15.3 cm), was recorded in plants treated with 1.5 % EMS treated plants, while the maximum plant height (34.1 cm) was recorded in low concentration 0.1% EMS treated plants at 150 days intervals. Also, it was observed that the plants treated with higher doses were dwarfed. It indicated that higher dose contribution decreased plant height. This variation in plant height might be due to the mutation on various genome loci (Rashid, 2021). Similar results on plant height were also obtained in sunflower at 0.5 % dose by Cvejić *et al.* (2011). This is the first report on money plant mutation, and findings reported dwarfness of the money plants at higher concentrations of EMS.

Conclusion

The present study concluded that various EMS concentrations greatly influenced different characteristics of the money plant species *Epipremnum aureum*. Maximum survival percentage (100%) occurred at 0.1%, 0.5 % EMS treated and untreated control. The minimum plant height, leaf length and width (15.3 cm, 2.40 cm and 1.20 cm) were also reported in the high-dose EMS-treated plants, leading to dwarfness. This dwarfness of the money plants can be the best solution for making different components of indoor landscaping/ interiorscaping. The present study recorded 150 days of interval observation and suggests that further studies need to obtain more compressive mutation.

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Conflict of interest

The author declare that they have no conflict of interest.

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