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The Effects of UV Radiation on Morphology of *Cadamine lyrata*

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Cadamine lyrata are planted to decorate the aquarium for a resident of the small fish and add beauty to the aquarium. They want to create a variety of looks from *C. lyrata* to achieve a new and more beautiful. Therefore conducted a study to establish the genetic diversity of *C. lyrata* using by the shoots was treated with UV concentrations of 30, 60, 90 and 120 Gray for 30, 60 and 90 minutes. The result found that *C. lyrata* through the UV irradiation at 90 Gray for 60 minutes gave the highest size of callus at 2.5 cm, number of shoot at 43.30/explant and shoot length at 6.01 cm significant different with another concentration of UV ($p \leq 0.01$). Noting that the natures of the callus through induced mutations are different from purplish brown callus and they are different from normal callus (green callus). The leaves are small, rounded edges. The stem is small and long petioles

Keywords: UV radiation, Morphology, *Cadamine lyrata*

Introduction

The scientific name of this aquatic plant is *Cadamine lyrata* that originated in Asia. They are grows well in temperatures up to 28 degrees celsius and depth of 20-50 cm with sand or sandy soil. Leaves, petiole and blade clearly distinctive feature is shaped green leaves round it was beautiful. They can stay underwater for a long time without frequent pruning and easy to maintenance. Fish can be fed with them. It is benefits of fish breeding. The fish can spawn with leaves as well. In nature, aquatic plants can be propagated by cuttings of seedlings were planted in sandy soil plot or convert wet sand. The plants species breeding can be quite difficult and slow growth in the breeding plots. As a result, farmers face a shortage in the production of commercial tree species (Rataj and Horeman, 1977). Currently has two ways for propagation which is cuttings and lead to 1-2 nodal into pots (Cook, 1996) and another is *in vitro*. Using the part of the plant is clean and free of bacteria were cultured on a synthetic media that

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contains minerals, vitamins and growth in aseptic technique (Laohavisuti and Mitrnoi, 2016). Another method can increase the number of species that have plenty of aquatic plants. Within a short time, as well as to control product quality in order to develop the business of manufacturing plants for export (Cook, 1996; Kane *et al*., 1990) and can create a variety of aquatic plant. Inducing a mutation was a novel manner and in order to decoration of aquarium. Therefore, in this study, aimed to increase the volume and studying the induced mutation of *C. lyrata*. UV is mutagen which is mutagenic basic, easy and safe to use as the basis for the use of mutagenic further.

Materials and methods

Shoot of *C. lyrata* were used for induce mutations by UV radiation that concentrations of 0, 30, 60, 90 and 120 Gy (Gray, Gy) for 30, 60 and 90 minutes after that culturing in solid MS medium supplemented with NAA 0.5 mg/l and BA 2 mg/l, 0.75% (w/v) agar, 3% (w/v) sucrose. The pH was adjusted to 5.7 with 1 N NaOH or HCl and the media were autoclaved at 121 ˚C at 15 p.s.i. (1.04 kg cmi^2) pressure for 15 min. The cultures were maintained at 27±1 ˚C under a 14-h photoperiod of 50 µmol m^{-2} s^{-1} irradiance provided by cool white fluorescent for three months. All the explants were placed on the medium. Observations were recorded every month of culture. Factorial in completely randomized design with 10 replicates (each replicate consists of 10 shoots) was designed. The size of callus, number of shoot, shoot length and other characteristic were recorded and compared among those radiations.

Results

Shoots of *C. lyrata* were treated with UV intensity and time for three months. After culturing for one week they are starting with callus formed. Saw calluses clearly in 2 weeks. Shoots through induced mutations from radiation, UV intensity of radiation to 90 Gy for 60 minutes gave the highest size of callus at 2.50 cm (table 1), followed by the irradiation of UV intensity levels of radiation 120 Gy for 90 minutes and irradiation of UV intensity levels of radiation 120 Gray's. 60 minutes with a callus 2.03 and 1.94 cm respectively, the difference was statistically significantly greater ($p \leq 0.01$) with UV radiation at concentrations and at other times. When considering the effects of UV radiation at various intensity levels. The average size of callus that irradiation of UV intensity levels of radiation 90 Gy gave 1.95 cm, followed by irradiation of UV intensity levels of radiation, 120 and 30 Gy has average size of calluses 1.92 and 1.71 cm respectively, the difference was statistically significantly greater ($p \leq 0.01$) with another intensity. For the time of calluses were irradiated for 60 minutes gave the highest average size of calluses at 1.84 cm, followed by irradiation for 30 and 90 minutes a callus averaging 1.64 and 1.61 cm respectively, significant different statistics ($p \leq 0.05$).

Considering the interaction between the intensity of UV radiation and the duration time of radiation on a callus of aquatic plant found that two factors affecting on size of calluses that significantly greater statistically ($p \leq 0.01$) (table 1).

Table 1 Sizes of callus of *Cadamine lyrata* after induced mutation with UV for three months.

The concentration of UV rays (Gy)	Size of callus (cm)			Average[1] concentration of UV rays
	Irradiation time (minutes)			
	30	60	90	
0	1.49[efg]	1.34[g]	1.54[defg]	1.46C
30	1.86[bcd]	1.75[bcde]	1.52[defg]	1.71B
60	1.40[fg] f	1.69[bcde]	1.30[g]	1.46C
90	f 1.70[bcde]	2.50[a]	1.64[cdefg]	1.95A
120	1.79[bcde]	1.94[bc]	2.03[b]	1.92A
Average[2] Irradiation time	1.64B	1.84A	1.61B	**
				CV.% 19.76

** = Significant difference at $P \leq 0.01$ level.
[1,2] = Value followed by different letter are significantly different according to DMRT.

Shoots through the irradiation of UV concentrations of 90 Gy for 60 minutes gave the highest number of shoot up to 43.30 shoot/explant (Table 2), followed by irradiation of UV concentration of 120 Gy for 90 and 60 minutes, gave the number of shoot 42.60 and 42.10 /explant respectively, significantly different ($p \leq 0.01$) with other intensity and time. The effects of UV radiation at various intensity levels 120 Gy gave the highest number of shoot 41.97 /explant, followed by irradiation of UV intensity levels of radiation at 90 and 60 Gy. They are gave the average number of shoot at 39.53 and 37.33/explant, respectively. They are significant different with another intensity. For the time, after irradiated for 60 minutes gave the highest average number of shoot at 37.48 /explant, followed by irradiation for 30 and 90 minutes a shoot averaging 37.20 and 36.28 shoot/explant, respectively. Numbers of shoot are not significant different statistics ($p > 0.05$) with another time.

Considering the interaction between intensity and duration of UV radiation in numbers of shoot found that two factors affecting on numbers of shoot of *C. lyrata* even statistically significant ($p \leq 0.01$).

Table 2 Number of shoot of *Cadamine lyrata* after induced mutation with UV for three months.

The concentration of UV rays (Gy)	Number of shoot (shoot/explant)			Average[1] concentration of UV rays
	Irradiation time (minutes)			
	30	60	90	
0	30.1^{f}	29.60^{f}	31.20^{f}	30.30D
30	38.20^{bc} d	33.50^{ef}	35.70^{de}	35.80C
60	9.70^{abcd}	38.90^{ab} cd	33.40^{ef}	37.33BC
90	36.80^{cd} e	43.30^{a}	38.50^{bc} d	39.53B
120	41.20^{ab} c	42.10^{ab}	42.60^{ab}	41.97A
Average[2] Irradiation time	37.20	37.48	36.28	**
				CV. 12.08%

** = Significant difference at P≤0.01 level.
[1,2] = Value followed by different letter are significantly different according to DMRT.

After culturing for three months found that irradiation of UV intensity levels of radiation 90 Gy for 60 minutes gave the highest of shoot length 6.01 cm (Table 3), followed by the irradiation of UV levels that intensity of radiation 120 Gy for 90 minutes and irradiation of UV intensity levels of radiation 120 Gy for 60 minutes with a shoot length of 5.64 and 5.46 cm respectively, the difference was statistically significantly greater (p≤0.01) with concentrations of UV radiation and other times. When considering the effects of UV radiation at various intensity levels. The shoot length of *C. lyrata* after treated with irradiation of UV intensity levels of radiation 90 Gy gave the highest of shoot length 5.28 cm, followed by irradiation of UV intensity levels of radiation 120 and 60 Gy. There's shoot length 5.27 and 4.57 cm respectively, a difference that was statistically significant (p≤0.01) with other intensity. Allowing for the radiation to the shoot length were irradiated for 60 minutes gave the highest average of shoot length 4.86 cm, followed by irradiation for 90 and 30 minutes gave the averages 4.56 and. 4.32 cm respectively differ statistically significantly greater (p≤0.01).

Considering the interaction between intensity and duration of UV radiation to shoot length found that two factors affecting on shoot length of *C. lyrata*, even a statistically significant (p≤0.01).

The observed results were found to induce mutations look like the following

1. Nature of callus through induced mutations are colored differently from the calluses usually through radiation, UV radiation intensity 60 and 90 minutes gave the callus is purplish brown. The normal callus is a green. (Fig. 1 and 2)

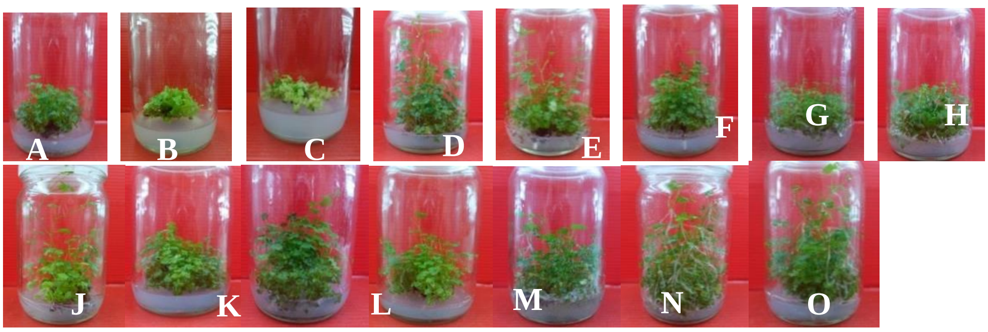

Figure 1 Characteristic of shoot of *Cadamine lyrata* after a three-month of culturing.

A – C : UV Concentration of 0 Gy for 30, 60 and 90 minutes.
D – F : UV concentration of 30 Gy for 30, 60 and 90 minutes.
G – I : UV concentration of 60 Gy for 30, 60 and 90 minutes.
J – L : UV concentration of 90 Gy for 30, 60 and 90 minutes.
M - O: UV concentration of 120 Gy for 30, 60 and 90 minutes.

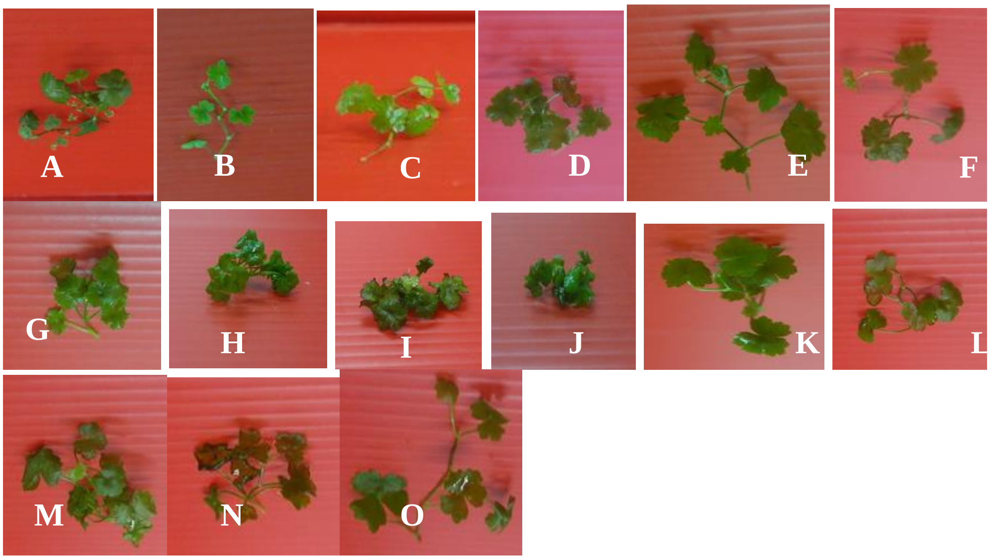

Figure 2 Characteristic of leaf of *Cadamine lyrata* after a three-month of culturing.

A – C : UV Concentration of 0 Gy for 30, 60 and 90 minutes.
D – F : UV concentration of 30 Gy for 30, 60 and 90 minutes.
G – I : UV concentration of 60 Gy for 30, 60 and 90 minutes.
J – L : UV concentration of 90 Gy for 30, 60 and 90 minutes.
M - O: UV concentration of 120 Gy for 30, 60 and 90 minutes.

2. Leaf through induced mutation looks different from the color of the leaf blade is usually through radiation, UV radiation intensity 30 Gy for 30 minutes gave the color of the leaves with white green leaves and the

intensity of radiation 120 Gy for 90 minutes gave the chimera, small and rounded edges. (Fig. 3 and 2)

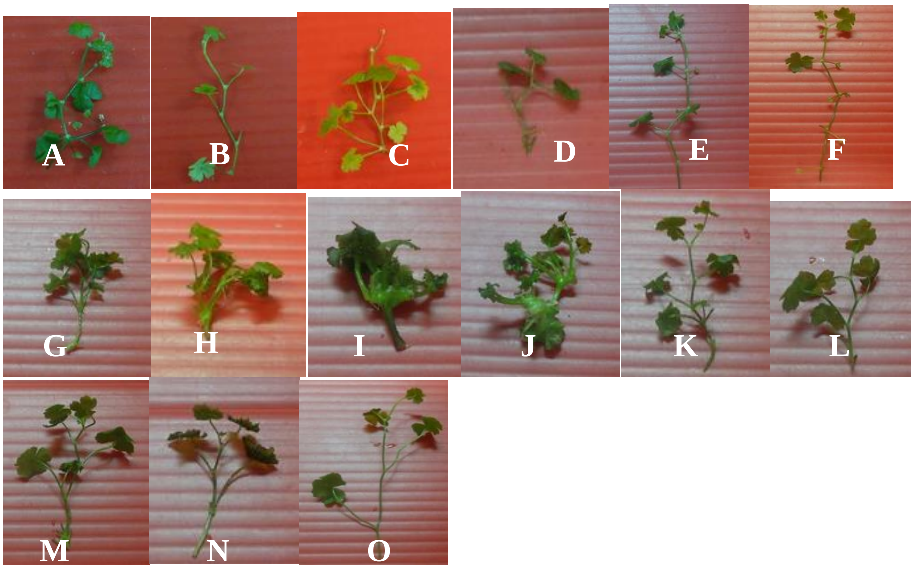

Figure 3 Characteristic of stem of *Cadamine lyrata* after a three-month of culturing.

A – C : UV Concentration of 0 Gy for 30, 60 and 90 minutes.
D – F : UV concentration of 30 Gy for 30, 60 and 90 minutes.
G – I : UV concentration of 60 Gy for 30, 60 and 90 minutes.
J – L : UV concentration of 90 Gy for 30, 60 and 90 minutes.
M - O: UV concentration of 120 Gy for 30, 60 and 90 minutes.

3. Stem gave from induced mutations are different from the normal, that smaller stems, plump juicy and long petioles. (Fig. 4 and 2)

Figure 4 The different characteristic of *Cadamine lyrata* through induced mutations.

A : Green with purple callus.
B-C : White green leaves and D-E : Chimera.

Table 3 Shoot length of *Cadamine lyrata* after induced mutation with UV for three months.

The concentration of UV rays (Gy)	Shoot length (cm)			Average[1] concentration of UV rays
	Irradiation time (minutes)			
	30	60	90	
0	3.63[gh]	3.50[h]	3.75[fgh]	3.63C
30	4.50[defg]	4.16[efgh]	3.80[fgh]	4.15B
60	4.01[efgh]	5.15[bcd]	4.56[def]	4.57B
90	4.78[bcde]	6.01[a]	5.06[bcd]	5.28A
120	4.70[cde]	5.46[abc]	5.64[ab]	5.27A
Average2 Irradiation time	4.32B	4.86A	4.56AB	** CV. 19.11%

** = Significant difference at $P \leq 0.01$ level.

[1,2] = Value followed by different letter are significantly different according to DMRT.

Discussions

The experiments revealed that the induced mutations by UV radiation at concentrations of 120 Gy are calluses largest 4.5 cm, number of shoot 27.76/explant. And shoot length at 20.59 cm. The mutagen was effect of stimulating the growth of aquatic plant. At the same time, it also inhibits the growth of them and decreases the shoot length. Pechkong *et al*. (2010) reported the radiation in *Cryptocoryne wendtii* "Tropica" and found that the radiation gave many characteristics of paddle such change color leaf from green to brown, red brown, red, pink and chimera. Pechkong (2008) studied the effect of radiation on aquatic plant. They found that paddle of *Cryptocoryne balansae* Gagnep had shorter, leaves changing color, leaf deformation and cracking leaves sprout a cluster. While *Anubias* spp. found that radiation affects the color of the leaves changing from green leaves to chimera and pygmy of stem (Phongchawee, 2013) Pongchawee (2009) reported that induced mutation in *Anubias* spp. with radiation together with tissue culture found that *Anubias* spp. became an early look shorter or dwarf, leaves size, leaf shape and leaf color changes. Pongchawee (2013) reported about induced mutation in *Anubias* spp. and *Cryptocoryne* using gamma radiation. Anubias leaves turn from green to chimera and *Cryptocoryne* leaves change color from green to red, brown, pink, orange and yellow. There is also a growth decline as the dose increases. The UV rays that impact both directly and indirectly to the inhibition of plant DNA and damage the photosynthesis process in plant composition changes. They are physical process and plant growth changes in biomass and yield reduction.

Conclusions

UV radiation at concentration of 90 Gray for 60 minutes gave the highest size of callus at 2.5 cm, number of shoot at 43.30/explant and shoot length at 6.01 cm. UV radiation at different concentrations gave the different expression of *C. lyrata*. The characteristic of them after treated with UV had purplish brown callus and they are different from normal callus (green callus). The leaves are small, leaves get chimera, small and rounded edges and stems are small, plump juicy and long petioles.

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