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Effects of Chronic Gamma Irradiation on Adventitious Plantlet Formation of *Saintpaulia ionantha* (African Violet) Detached Leaves

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ABSTRACT

Formation of adventitious plantlets on unrootedly detached leaves of two African violet (*Saintpaulia ionantha*) cultivars, pink and violet flowers, chronically gamma-irradiated in gamma room at The Gamma Irradiation Service and Nuclear Technology Research Center, Kasetsart University was compared. Detached leaves were immediately planted after detachment in plastic trays containing peat moss, 18 leaves per treatment with 3 replications. Three dose rates (rad/h) with 3 doses (rad)/dose rate, were applied to the irradiated samples while the controls were placed outside the gamma room. Three months after irradiation, the number of survived leaves, the number of leaves producing adventitious plantlets and the number of plantlets per leaf were recorded. After that, the young plantlets were transferred to the new pots for further observation on plant growth and mutation characters.

The results revealed that the number of survived leaves, the number of leaves producing adventitious plantlets and the number of plantlets per leaf varied slightly with radiation doses but were not significantly different at different dose rates. Radiosensitivity was noticed to be higher in pink flower cultivar than the violet one. M_1V_1 plantlets will be followed up for growth and mutation character observations.

Key words: African violet, *Saintpaulia ionantha,* adventitious plantlet, gamma-rays, chronic irradiation

INTRODUCTION

The usual method of *in vivo* propagation of *Saintpaulia* (African violet) is the one by means of leaf cuttings or detached leaves which after rooting, produce adventitious buds at the bases of the petioles and ultimately develop into several plantlets. The number of plantlets depends on the cultivar, environmental conditions as well as the application of growth regulators (Scott and Marston, 1967). African violet was the first species demonstrated the apex of an adventitious bud on a detached leaf ultimately originate from a single epidermal cell (Naylor and Johnson, 1937; Sparrow *et al.,* 1960). All adventitious plantlets turn out to be non-chimerical. They are either completely normal or completely solid mutants after irradiation; this is in general advantageous for use in mutation breeding (Sparrow *et al.,* 1960). Since the diplontic selection is reduced to a minimum, the mutation frequency is high (±30% of the plantlets are visible mutants after an optimal

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acute X-ray dose of 5 krad) and the mutation spectrum is very wide (Broertjes, 1968).

Broertjes (1971, 1972) used the formation of adventitious plantlets on detached leaves of African violet to study the effect of acute, chronic or fractionated irradiation with X-rays or fast neutrons and found that, under certain conditions and with certain treatments, more mutants per 100 irradiated leaves were produced than was the case with the optimum acute dose. Treatments with such effect were a pre-treatment with 800 rad X-rays and a second dose of 6 krad separated by an 8-h interval and a similar treatment with fast neutrons. Other treatments (repeated irradiation, chronic irradiation) gave even higher percentages. The objective of this study was to compare the effects of chronic gamma irradiation on adventitious plantlet formation of two cultivars of *Saintpaulia ionantha* detached leaves.

MATERIALS AND METHODS

Two African violet (*Saintpaulia ionantha*) cultivars, pink and violet flowers were grown under natural light condition in a greenhouse. Healthy leaves of greenhouse stock plants of both cultivars were immediately planted in plastic trays containing peat moss after detachment (Figure 1), 18 leaves per treatment with 3 replications. The leaf samples were then chronically irradiated by gamma rays in the gamma room of the Gamma Irradiation Service and Nuclear Technology Research Center, Kasetsart University whereas the controls were placed outside the gamma room. Three dose rates of gamma rays (31.97, 24.48 and 15.67 rad/h) with 3 doses/dose rate were applied to the irradiated samples. The irradiation times varied from 8 to 14 days depending on the total doses. After irradiation, all samples were brought back to the greenhouse.

Three months after irradiation, the number of survived leaves, the number of leaves producing adventitious plantlets and the number of plantlets per treatment were recorded. Leaf survival, % leaf producing plantlets and the

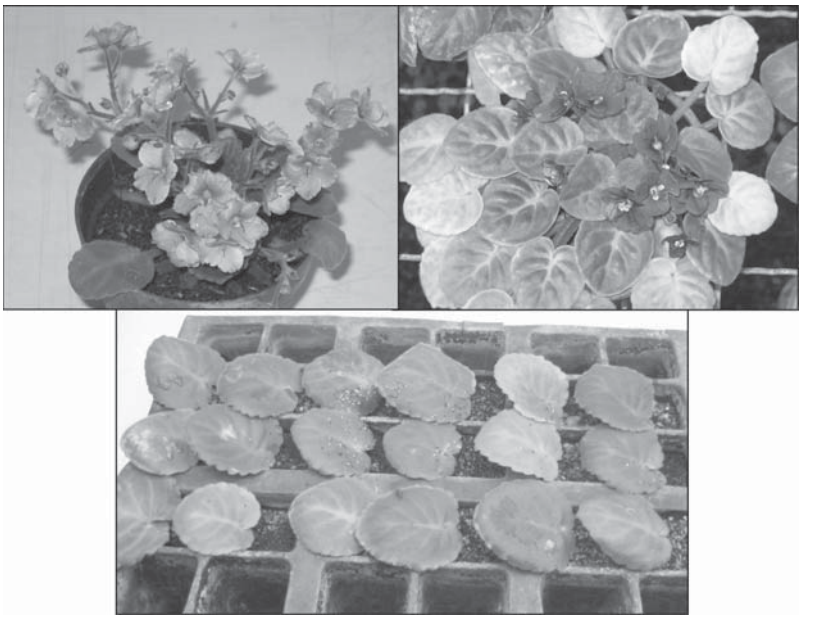

Figure 1 Two cultivars of *Saintpaulia ionantha*, pink (upper left) and violet (upper right) flowers used in the experiment with detached leaves planted in plastic trays (lower) before irradiation.

number of plantlets per leaf were then calculated. Analysis of variance followed by the least significant different (LSD) test was used to determine the differences in mean numbers of all tested parameters between the samples.

RESULTS AND DISCUSSION

The effects of doses and dose rates of gamma rays on leaf survival, the number of leaves producing plantlets and the number of plantlets per leaf are summarized in Table 1. Comparisons on leaves producing plantlets (as % of control) and the number of plantlets per leaf of two African violet cultivars treated with different doses and dose rates of gamma-rays are shown in Figures 2 and 3, respectively. It was observed that total doses and dose rates used in this experiment had no effect on survival of the irradiated leaves. The results from ANOVA indicated that there were significant differences in the number of leaves producing plantlets and the number of plantlets per leaf between non-irradiated control and irradiated with gamma-rays at any dose and dose rate of both cultivars. Gamma radiation inhibited the number of leaves producing plantlets and the number of plantlets per leaf of both cultivars when compared to the untreated control except the treatment of violet flower cultivar treated with 2319 rad at 15.67 rad/h of gamma-rays. In the mentioned treatment, the number of leaves producing plantlets was higher than its control but the production of plantlets per leaf was not significantly different from the control. At higher dose rates (31.97 and 24.48 rad/h), pink flower cultivar tended to have higher sensitivity to radiation than violet flower cultivar, regarding to the number of leaves producing plantlets, but had similar radiosensitivity at lower dose rate (15.67 rad/h) (Figure 2). According to Plummer and Leopold (1957) and Scott and Marston (1967), African violet readily reproduced from the detached leaves which, after rooting, produced several or many plantlets at the bases of petioles of rooted detached leaves. The number of plantlets depended on the cultivar, environmental conditions and the applied growth hormones. In this experiment, the results showed that the regeneration potential of detached leaves of different *Saintpaulia ionantha* cultivars after chronically irradiation with gamma rays varied considerably. All treatments gave lower number of plantlets per leaf than the control. Comparison among dose rates indicated that when detached leaves were irradiated with decreasing dose rate down to 15.67 rad/h, there was only a slight shift towards an increasing dose. The result was similar to the experiment reported by Broertjes (1968).

Pink flower cultivar treated with 4732 rad (at 31.97 rad/h), showed abnormal adventitious shoots, i.e. the adventitious buds gave flowers instead of young plantlets as shown in Figure 4. Malformed leaves of M_1V_1 plantlets were also noticed. The obtained results suggested that mutation spectrum and frequency should be further observed.

CONCLUSIONS

The experiment revealed that detached leaf survival was not affected by either radiation dose or dose rate. The number of leaves producing plantlets and the number of plantlet formation per detached leaf of *Saintpaulia ionantha* chronically irradiated with gamma-rays varied slightly with radiation doses and dose rates. The variation in adventitious plantlet regeneration was apparently depending on genetically difference.

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Table 1 Leaf survival, the number of leaves producing plantlets and the number of plantlets/leaf of two African violet cultivar (pink and violet flowers) detached leaves chronically irradiated with gamma-rays at different doses and dose rates.

Treatment	Dose rate (rad/h)	Total dose (rad)	Pink flower			Violet flower		
			Leaf survival (as % of control)	Leaf producing plantlets (as % of control)	No. plantlets/leaf	Leaf survival (as % of control)	Leaf producing plantlets (as % of control)	No. plantlets/leaf
T1 (control)	-	-	100	100	4.06	100	100.00	3.36
T2	31.97	4732	100	56.56	1.12	100	66.67	1.17
T3	31.97	7545	100	61.11	1.50	100	66.67	0.89
T4	31.97	8824	100	61.11	2.20	100	40.00	0.44
T5	24.48	3623	94	61.11	1.72	100	73.34	1.06
T6	24.48	5777	100	61.11	1.61	100	66.67	1.22
T7	24.48	6757	100	55.56	1.61	94	86.67	1.72
T8	15.67	2319	100	61.11	1.50	100	106.67	3.11
T9	15.67	3698	100	72.22	2.28	100	60.00	1.61
T10	15.67	4325	100	55.56	1.17	100	66.67	1.38
C.V. (%)				21.60	25.60		19.90	28.20
LSD				23.75	0.82		24.88	0.78

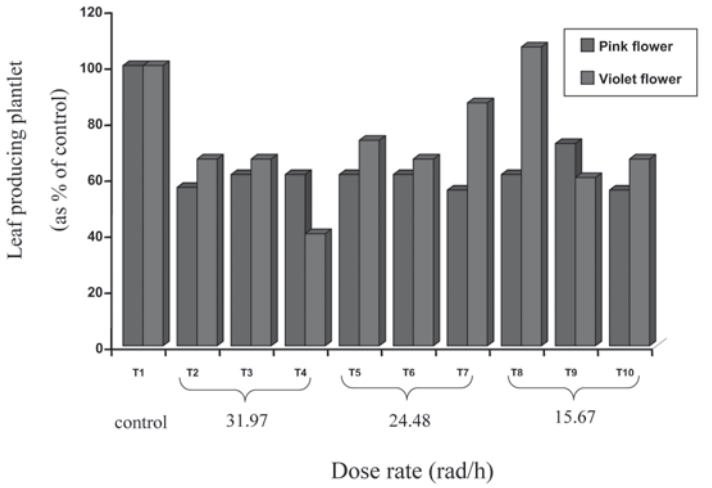

Figure 2 The number of leaves producing plantlets of two African violet cultivars (pink and violet flowers) 3 months after treating detached leaves with chronic gamma-rays at different doses and dose rates.
T1 – control; T2 – 4732 rad; T3 – 7545 rad; T4 – 8824 rad; T5 – 3623 rad; T6 – 5777 rad; T7 – 6757 rad; T8 – 2319 rad; T9 – 3698 rad; T10 – 4325 rad

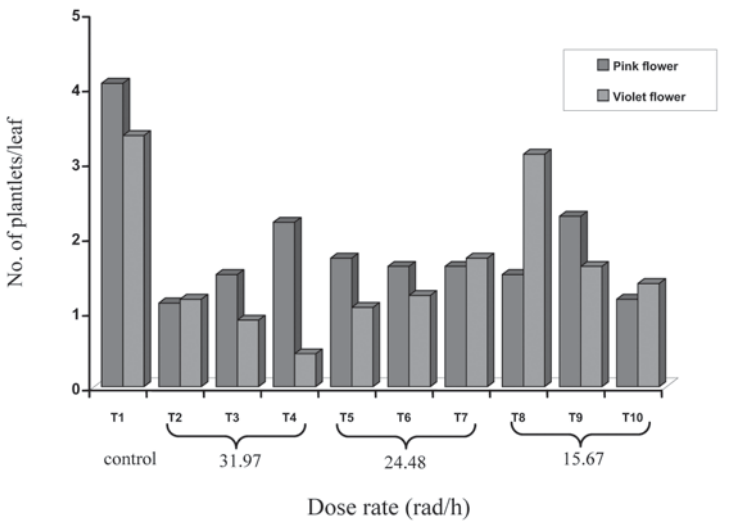

Figure 3 The number of plantlets/leaf of two African violet cultivars (pink and violet flowers) 3 months after treating detached leaves with chronic gamma-rays at different doses and dose rates.
T1 – control; T2 – 4732 rad; T3 – 7545 rad; T4 – 8824 rad; T5 – 3623 rad; T6 – 5777 rad; T7 – 6757 rad; T8 – 2319 rad; T9 – 3698 rad; T10 – 4325 rad

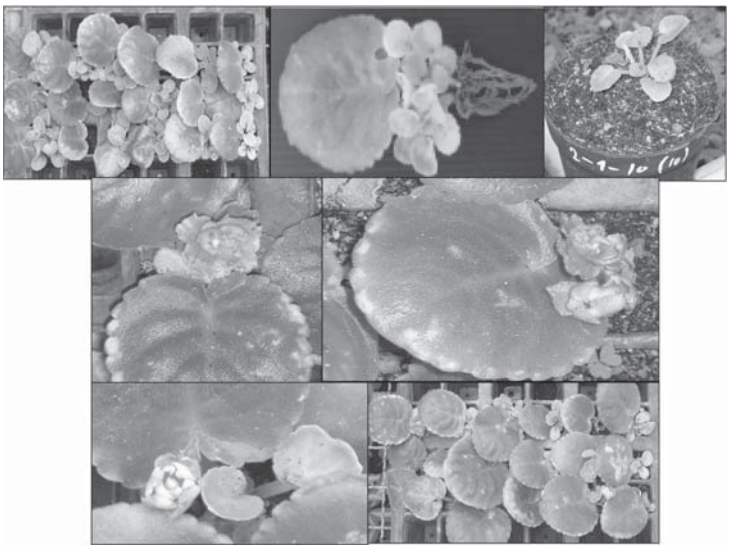

Figure 4 Young adventitious plantlets were grown from detached leaves (upper) and were then transplanted into the plastic pots. Some abnormal adventitious buds (flowers) were formed instead of plantlets (middle and lower).

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