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Photosynthetic activity and photoinhibition in seedlings of red pepper (*Capsicum annuum* L.) grown from low dose γ-irradiated seeds

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The seedling height, leaf width and leaf length of pepper increased in plants grown from seeds irradiated with the low dose of 4 Gy. The O_2 evolution in the 4 Gy irradiation group was 1.5 times greater than the control. Pmax was decreased with increasing illumination time by 20% in the control, while hardly decreased in the 4 Gy irradiation group. Fv/Fm was decreased with increasing illumination time by 50% after 4 hours, while Fv/Fm in the 4 Gy irradiation group was decreased by 37% of inhibition, indicating that the low dose γ radiation increased resistance of plants to photoinhibition.

Key words : Low dose γ radiation, pepper, photosynthesis, photoinhibition

INTRODUCTION

Hormesis is defined as positive and stimulating effect on organism by the low dose of agent. Accelerated germination, growth, blooming and ripening, and increased crop yield in higher plants grown from seeds irradiated with low dose radiation were observed [1]. This paper evaluated the stimulating effects of low dose γ radiation on the growth of cultivars, physiological activities and photosynthetic responses of pepper to high light stress.

MATERIALS AND METHODS

Dry seeds of red pepper (*Capsicum annuum* L.) were irradiated with 0 and 4 Gy by irradiator (^{60}Co, ca.150 TBq of capacity, AECL). After irradiation, seeds were grown in the green house.Fluorescence parameters were measured with PAM fluorometer at room temperature [2]. The oxygen evolution was measured in air enriched with 1% CO_2 using a leaf-disc oxygen electrode. Photoinhibitin was induced at 900 μmol/m^2/s at 25℃.

RESULTS

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Table 1. Growth characteristics of pepper developed from seeds irradiated with different doses of γ radiation.

Traits	Irradiation dose (Gy)	
	0	4
Germination rate (%)	92.0 ± 2.0†	87 ± 3.4
Seedling Height (cm)	17.8 ± 0.2	20 ± 0.6
Leaf Width (cm)	3.60 ± 0.2	4.4 ± 0.3
Leaf Length (cm)	7.00 ± 0.0	7.9 ± 0.2
Chl a/b	2.82 ± 0.2	3.11 ± 0.1
Chl Content (μmol/m^2)	308 ± 16	345 ± 24

†: Mean ± standard error(n=3).

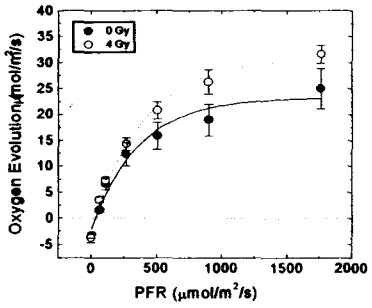


Fig. 1. Changes in the O_2 evolution in pepper leaf discs as a function of photon fluence rate (PFR). ●, Control; ○, 4 Gy treatment.

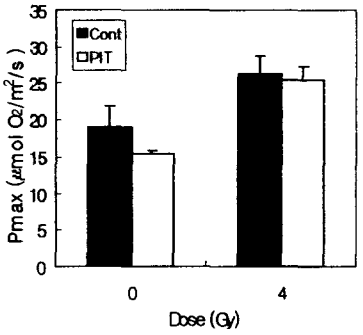
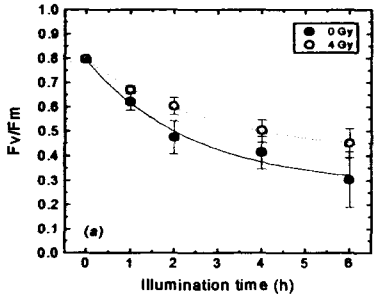


Fig. 2. Changes in the maximal photosynthetic O_2 evolution (Pmax) in pepper leaf discs with PIT or without PIT(Cont).



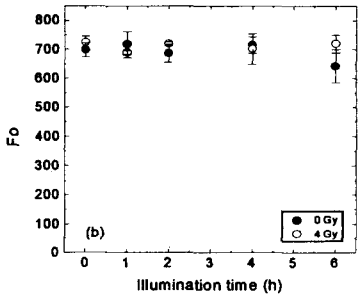


Fig. 3. (a)Changes in the maximal photochemical efficiency of PSII (Fv/Fm) as a function of illumination time. (b)Changes in dark-level fluorescence yield, Fo as a function of illumination time.

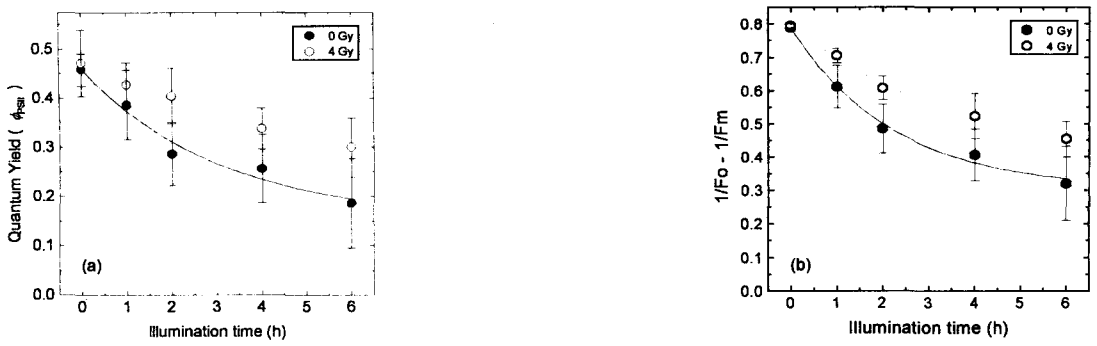


Fig. 4. (a)Changes in the effective quantum yield of photochemical energy conversion at PSII reaction centers, Φ_{PSII} with illumination time. (b)Changes in the fluorescence parameter, 1/Fo-1/Fm with illumination time. Pepper leaf discs were exposed to 900 μmol/m^2/s at 25 ℃. ●, Control ; ○, 4 Gy treatment.

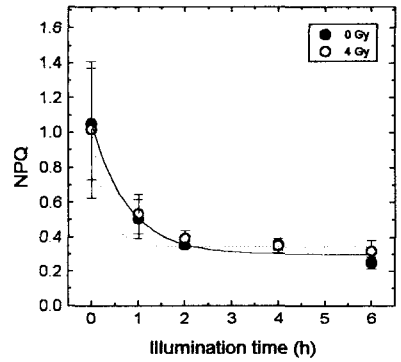


Fig. 5 Changes of the non-photochemical quenching, NPQ, in pepper leaves as a function of illumination time. Pepper leaf discs were exposed to 900 μ mol/m^2/s at 25 ℃. ●, Control ; ○, 4 Gy treatment.

CONCLUSION

These results showed the positive effect of low dose γ radiation on the seedling growth or physiological activities of pepper via increasing resistance of photosynthetic apparatus to high light stress.

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