Regulation of flavonoid production in the leaves of bell pepper by light condition.

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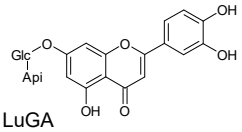
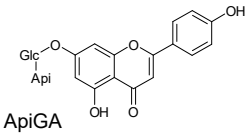
Introduction

Bell pepper, Capsicum annuum L. 'grossum', is one of important vegetable food and cultivated in all over the world. Our previous investigation revealed that LuGA (luteolin 7-O-β-apiosyl-(1→2)-O-β-glucoside) was contained in bell pepper leaves as an oviposition deterrent against a leaf miner fly (*Liriomyza torifolii*). The aglycon, luteolin, is well known as an antioxidant, antibacterial agent, and anti-inflammatory agent, thus luteolin could be used for a medicine or a health supplement. However, the luteolin amount in leaves is not enough to commercially using in the case of almost cultivar species, and apigenin (ApiGA), which is difficult to separate from LuGA, is also occurred in bell pepper leaves. Therefore, it is required to improve quantity and quality of flavonoids contents in bell pepper leaves. Flavonoids are one of major secondly metabolites in plants and act as resistance compounds against pests, UV absorbers, and floral pigments. Therefore, accumulation of flavonoids in plant is affected by various environmental conditions. In this study, we have tried to develop a control method of LuGA accumulation by light condition.



LuGA
Luteolin 7-*O*-apiosylglucosid



ApiGA
Apigenin 7-*O*-apiosylglucosid

Fig. 1 Bell pepper (*Capsicum annuum* L.'grossum')

Material and Method

Bell pepper seeds (cv. Kyonami) were sown on a small nursery pot (4 x 4 x 5 cm) containing vermiculite, the pots was cultivated in a growth chamber (25±3℃, 16L:8D) until the cotyledon stage. Four seedlings at the cotyledon stage were arranged in below a spectrum conversion film (Blue(abs:320-400nm, emit:460nm), Yellow(abs:480-530nm, emit:580nm), Red(abs:480-530nm, emit:630nm), Near IR (bear infrared, abs:580-680nm, emit:740nm)) or an LED light (Red: 637nm, Yellow: 601nm, Green: 521nm, Blue: 463nm, White: 557, 447). The seedlings were kept in a growth chamber (25±3℃, 16L:8D) for 2 weeks, and leaves and stems were separately extracted with methanol. Extracts were analyzed by an HPLC system (Nexsera HPLC system, Shimadzu, Inertsil ODS-4, ID 4.6 mm x 75 mm, detection at 320 nm).

Result and Discussion

To investigate effects of the spectrum conversion films on plant growth, bell pepper seedlings were incubated in a growth chamber for 2 weeks. Height of seedling covered with the Blue, Yellow, Red, Near IR, and control film was 86.5, 92.8, 90.6, 86.8, and 90.9 mm, respectively (Table 1). The plant height in the Blue and the Near IR film was slightly lower than that in the control film, however, the leaf length of seedlings covered with each spectrum conversion film was the almost same as the control length. On the other hand, the fresh weight of bell pepper seedling was affected by light conversion films, namely, the fresh weight of stem in the Red and the Near IR film was 15-25% lower than the control weight. Similarly, the fresh weight of leaves in the Near IR film was ca.10% lower than the control fresh weight. Therefore, it was considered the Near IR film to cause a growth inhibition.

Table 1 Effect of spectrum conversion films on plant growth

Type of light conversion films		Plant height (mm)	Leaf length (mm)	Fresh weight (mg) Leaf	cotyledon	steam
Control		90.9	62.6	854	196	472
Blue	(abs:320-400nm, emit:460nm)	86.5	62.1	828	217	432
Yellow	(abs:480-530nm, emit:580nm)	92.8	61.3	843	211	458
Red	(abs:480-530nm, emit:630nm)	90.6	62.3	732	213	368
Near IR	(abs:580-680nm, emit:740nm)	86.8	64.3	794	186	417

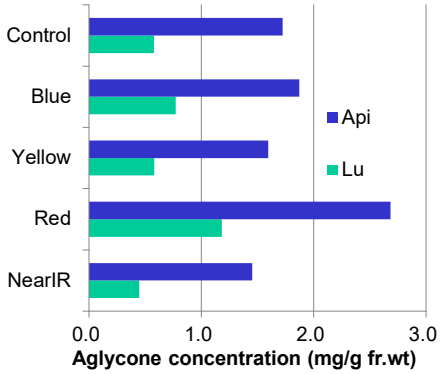


Fig. 2 Effect of spectrum conversion films on flavnoids production in bell pepper.

Next, a flavonoids accumulation in bell pepper seedling covered with a film was analyzed by HPLC (Fig. 2). The luteolin accumulation amount in the Red and the Blue film increased to 1.3-fold and 2.0-fold of that in control, respectively. However, the luteolin amount in the Near IR film decreased to 80%. Similarly, the apigenin amount also increased in the Red film and decreased in the Near IR film. From these results, the Red and the Near IR films were not prefer for plant growth, and the Red and the Blue films were prefer for a production of flavonoids. Therefore, the Blue film could be utilized for a production of luteolin in bell pepper leaves.

The effect of flavonoids accumulation in the Blue film would be due to an increasing of light intensity at wavelength of 460 nm and/or a decreasing of that of 320-400 nm. Next, an effect of the light wavelength on flavonoids production was investigated.

Table 2 Effect of LED light on plant growth

	White	Green	Red	Blue	Yellow
Wavelength (nm)	447&530	523	634	465	604
Plant Heiht (mm)	91	97	112	98	80
Leaf length (mm)	64	67	70	51	55
Leaf fresh weight (mg)	968	708	843	703	269
Plant age (leaf number)	6.7	6.2	6.9	7.1	4.8

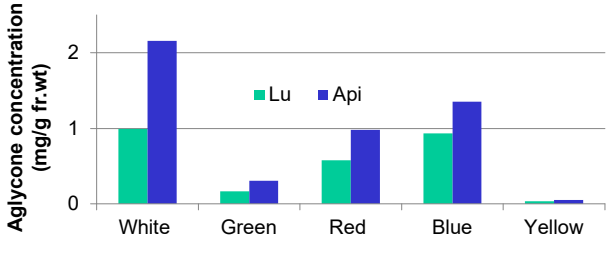


Fig. 3 Effect of LED light on flavnoids production.

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