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Compact 3U as a novel lighting source for the propagation of some horticultural plants

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Abstract

A novel lighting system (Compact 3U) was successfully applied to the micropropagation of some horticultural plants. *Cymbidium* 'Tim Hot', *Lilium longiflorum* and *Fragaria vesca* cv. 'My Da' shoots were used for this study. To compare *in vitro* growth of plantlets placed under Neon and Compact 3U lighting systems, *Fragaria vesca* cv. 'My Da' shoots were cultured on ½ MS medium supplemented with 1 gl^{-1} activated charcoal, 30 gl^{-1} sucrose and 8 gl^{-1} agar under two lighting sources at 45 $\mu molm^{-2}s^{-1}$. After three weeks of culture, the shoot and root length, leaf area and fresh weight of strawberry plantlets under Compact 3U system were significantly higher than those grown under Neon system. To clarify the effect of irradiance of Compact 3U system on the development of plantlets, *Cymbidium* 'Tim Hot' shoots were cultured on MS medium supplemented with 0.5 mgl^{-1} NAA, 1 gl^{-1} activated charcoal, 100% coconut water, 25 gl^{-1} sucrose and 8 gl^{-1} agar, *Lilium longiflorum* and *Fragaria vesca* cv. 'My Da' shoots were cultured on ½ MS medium supplemented with 1 gl^{-1} activated charcoal, 30 gl^{-1} sucrose and 8 gl^{-1} agar at different irradiances: (1) Neon at 45 $\mu molm^{-2}s^{-1}$ (control), and Compact 3U at: (2) 45 $\mu molm^{-2}s^{-1}$, (3) 60 $\mu molm^{-2}s^{-1}$, and (4) 75 $\mu molm^{-2}s^{-1}$. The results showed that plantlets of the three genera adapted differently to irradiances and lighting sources, but in all, the growth of plantlets were better under the Compact 3U system. Futhermore, *ex vitro* plantlets derived from Compact 3U system also developed better than those from Neon system.

Key words: Compact 3U, Neon, *Cymbidium* 'Tim Hot', *Lilium longiflorum*, *Fragaria vesca* cv. 'My Da'

Introduction

Now-a-days, *in vitro* multiplication is a primary method to rapidly mass-produce horticultural plants. The demand for high quality planting material has been increasing quickly worldwide for reforestation, foods/forage production, urban/indoor horticulture and global environment protection (Kozai *et al.*, 1992). In many cases, since micropropagation gave some superior transplant qualities to seedling production and conventional vegetative production, billions of micropropagated plantlets were produced annually world-wide (Debergh and Zimmerman, 1990). Tissue culture has been carried out in more than 600 companies all over the world. However, the widespread use of micropropagation for major crops in agriculture and horticulture was restricted because of its relatively high production costs caused by high labour cost (Kozai *et al.*, 1992), especially electrical energy consumption.

Control of plantlet growth and morphology is important in micropropagation to obtain high plantlet quality at different growth and developmental stages, and to save labour by automation or robotics (Miyashita, 1995). Many of the growth and morphological characteristics of plants *in* and *ex vitro* are influenced by environmental factors, such as light (quality, intensity, duration and direction), temperature, gaseous composition (CO_2, O_2, H_2O and C_2H_4), and medium composition (Schwabe, 1963; Kozai *et al.*, 1992). Light quality had a significant influence on the growth and morphology of plants *in* and *ex vitro* (Warrington and Michell, 1976; Morgan and Smith, 1981; Smith, 1982; Tibbitts *et al.*, 1983; Mortensen and Stromme, 1987; Economou and Read, 1987; Agrawal, 1992). The total quantity of light that a plant received during illumination directly affected photosynthesis as well as plant growth and yield (Kim and Kozai, 2000). Hence, many lighting systems that effectively used electrical energy in the multiplication of horticultural plants have been studied intensively such as fluorescent, incandescent, luminescent (Sodium high pressure) lighting systems, and recently, light-emitting diode (LED) lighting source. However, tissue cultured plants are almost invariably grown under fluorescent illumination (Collin *et al.*, 1988), especially under cool white fluorescent lamps with a high proportion of its output in the blue and red regions (Hart, 1988).

Previous studies had been done on the effect of light quality and intensity of different lighting sources on the growth and morphology of *in* and *ex vitro* plantlets (Seabrook, 1987; Hayashi *et al.*, 1992; Iwanami *et al.*, 1992; Kozai *et al.*, 1992; Kirdmanee *et al.*, 1993; Gabarkiewicz *et al.*, 1997; Wulster and Janes, 1997; Maas and Bakx, 1997; Kunneman and Ruesink, 1997; Moe, 1997; Faust and Heins, 1997; Murakami *et al.*, 1997; Gabryszewska and Rudnicki, 1997; Walz and Horn, 1997; Miyashita *et al.*, 1997; Nhut, 2002). In our study, Compact 3U lamps were used as a promising lighting source for propagating some horticultural plants such as *Cymbidium*, *Lilium* and strawberry. These plants are highly valuable economic crops in Vietnam as well as all over the world. In this report, we focused on the effects of two different lighting sources (Neon and Compact 3U) as well as some different intensities of Compact 3U lamps (45, 60, and 75 $\mu molm^{-2}s^{-1}$, respectively) on the growth and morphology of these *in vitro* plantlets, and Neon lamp (with cool white emission) as a control system.

Compact 3U lamp (Fig. 1), which saves 80% electrical energy

as compared to incandescent lamps, has a compact size, long life (>6.000 h), and reaches one-fifth the brightness of conventional incandescent lamps. Hence, plant production cost could be decreased.

Materials and methods

Plant materials and culture media: *Cymbidium* 'Tim Hot' shoots (4 cm length), derived from protocorm-like bodies (PLBs) cultured on MS (Murashige and Skoog, 1962) medium containing 0.5 mgl^{-1} α-naphthaleneacetic acid (NAA), 2 mgl^{-1} 6-benzyladenine (BA), 1 gl^{-1} activated charcoal (AC), 20% coconut water (CW), 30 gl^{-1} sucrose and 8 gl^{-1} agar (Haiphong Co., Vietnam), were cultured on MS medium containing 0.5 mgl^{-1} NAA, 1 gl^{-1} AC, 10% CW, 25 gl^{-1} sucrose and 8 gl^{-1} agar.

Lilium longiflorum bulb scales, derived from *in vitro* bulblets cultured on MS medium containing 0.2 - 0.5 mgl^{-1} BA, 30 gl^{-1} sucrose and 8 gl^{-1} agar, were cultured on ½ MS medium supplemented with 1 gl^{-1} AC, 30 gl^{-1} sucrose and 8 gl^{-1} agar.

Fragaria vesca cv. 'My Da' shoots (1.5 cm), derived from meristems cultured on MS medium containing vitamin B_5, 0.2 mgl^{-1} BA, 30 gl^{-1} sucrose and 8 gl^{-1} agar, were cultured on ½ MS medium supplemented with 1 gl^{-1} AC, 30 gl^{-1} sucrose and 8 gl^{-1} agar.

For all experiments, explants were cultured in vessels (500 ml) containing 60 ml medium. pH of media was adjusted to 5.7 before autoclaving at 121°C, 1 atm for 40 min.

Lighting systems: Cool white fluorescent lamps (Neon tubes) (40 W each; Rang Dong Light source and Vacuum Flask Co., Vietnam, FL-40W/T10) and warm white fluorescent lamps (Compact 3U lamps) (18 W each; Rang Dong Light source and Vacuum Flask Co., Vietnam, CFH-3U18W) were used as lighting sources in each experiment.

Irradiances were 45 $\mu molm^{-2}s^{-1}$ under Neon light or 45, 60, 75 $\mu molm^{-2}s^{-1}$ for Compact 3U system according to each experiment. Photosynthetic photon flux density (PPFD) was measured with an illumination meter (Tokyo photoelectric Co., LTD., Japan, ANA-F11) on the empty culture shelf.

Experimental designs

Effect of Compact 3U lighting source on the *in vitro* development of *Fragaria vesca* cv. 'My Da' plantlets: Five strawberry shoots were cultured in each culture vessel, and ten vessels were placed on the shelf in one row under the Compact 3U lighting system with three lamps per shelf, arranged in one row. Ten other vessels were placed in one row on another shelf under the Neon lighting system at 45 $\mu mol\ m^{-2}\ s^{-1}$ (the control lighting system). After three weeks of culture, some morphological parameters (plant height and fresh weight, root length, leaf area) were recorded and the *in vitro* plantlets were transplanted to the greenhouse.

Effect of different irradiances of Compact 3U on the *in vitro* development of *Cymbidium, Lilium* and strawberry plantlets: Each vessel contained five shoots of each plant (*Cymbidium*, *Lilium* and strawberry). There were four shelves (ten vessels per shelf) with different irradiances: three shelves with the Compact 3U lighting system at either 45, 60 or 75 $\mu molm^{-2}s^{-1}$, and the remaining shelf with the Neon lighting system at 45 $\mu molm^{-2}s^{-1}$. Some morphological parameters of strawberry plantlets (plant height, leaf area, root length, and plant fresh weight) were recorded after three weeks of culture, of *Cymbidium* (plant height, root length, leaf area, number of newly formed roots, number of bulbs, bulb diameter, bulb cluster fresh weight and bulb fresh weight) and of *Lilium* (plant height, root length, leaf width, number of roots and plant fresh weight) were recorded after six weeks of culture.

The process to set up the Compact 3U and Neon lighting sources for studying *in vitro* development of some horticultural plants is depicted in Fig. 2.

The *in vitro* plantlets were thereafter transplanted to greenhouse. This subsequent stage of development of *Lilium* and *Cymbidium* plantlets were placed under 6h/day supplemental Compact 3U lighting source. After one and a half months of culture, plant

Fig. 1. Compact 3U lamp.

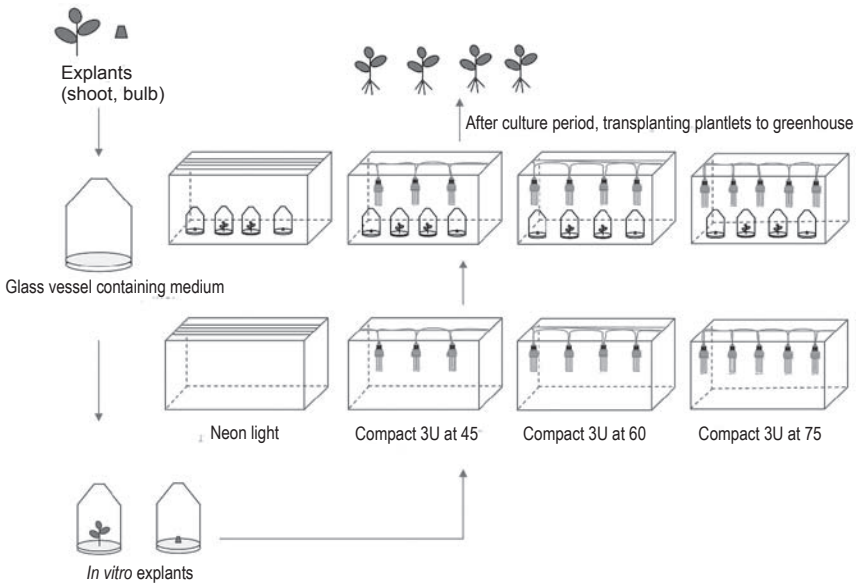

Fig. 2. Setting up the Compact 3U and Neon lighting sources for studying *in vitro* growth and development of some horticultural plants.

height, leaf width, number of leaves, number of roots, root length and plant fresh weight of *Cymbidium* and plant height, bulblet diameter, leaf width, number of leaves, number of roots, root length, and plant fresh weight of *Lilium* were collected.

Culture conditions (*in* and *ex vitro*): *In vitro* cultures were incubated at 25 ± 2°C with a ten-hour photoperiod and 75-80% relative humidity under different lighting systems as treatment.

After six weeks of culture, *Cymbidium* and *Lilium* plantlets were transplanted to the greenhouse and cultured on tree fern fiber substrate in spongy trays at 25 ± 2°C, 80-85% relative humidity and under 6h/day supplemental Compact 3U lighting source. Plantlets were sprayed with an antifungal solution containing 5 gl^{-1} Dithane M-45 (Dow AgroSciences Co., USA) twice a week. In addition, these plantlets were sprayed with a pesticide solution containing 150 gl^{-1} Sumi alpha (Omo Chemical Ltd., Co., Japan) and fertilizer solution containing 100 gl^{-1} NPK, 50 gl^{-1} Komix BFC 201 (Thien Sinh Biochemical Agriculture and Trade Co., Vietnam) and 15 gl^{-1} Miracle Fort (Phu Hung Foundation, Vietnam) once a week. Moreover, plantlets were also watered twice daily.

Statistical analysis: Each treatment was repeated three times and data was recorded at the 3rd or 6th week of culture. The explants in experiments were arranged in a randomized complete block design with five shoots per treatment and three blocks. The data were analyzed for significance using analysis of variance with the mean separation by Duncan's multiple range test (Duncan, 1995).

Results and discussion

Effect of Compact 3U lighting system on the *in vitro* development of *Fragaria vesca* cv. 'My Da' plantlets: The effect of the Compact 3U and Neon lighting source on the *in vitro* growth and development of strawberry plantlets are described in Table 1 and Fig. 3a. There was a significant difference in plant height, root length, leaf area and plant fresh weight between plantlets placed under two lighting systems at 45 $\mu molm^{-2}s^{-1}$. The morphological parameters of strawberry cultured under Compact 3U were higher than those under Neon lighting system.

Table 1. Effect of the Compact 3U lighting source on the *in vitro* development of *Fragaria vesca* cv. 'My Da' plantlets after 3 weeks of culture

Lighting system	Plant height (cm)	Leaf area (mm^2)	Root length (cm)	Plant fresh weight (mg)
Neon (control)	3.7b	45a	2.5b	200b
Compact 3U	4.2a	35b	3.5a	300a

Different letters within a column indicate significant differences ($P = 0.05$) by Duncan's multiple range test.

Effect of different irradiances of Compact 3U lighting source on the *in vitro* development of *Cymbidium, Lilium* and strawberry plantlets

***Fragaria vesca* cv. `My Da'**: The effect of different Compact 3U irradiances on the *in vitro* development of strawberry is shown in Table 2. In general, *in vitro* strawberry shoots placed under the Neon lighting system had a slower growth than those placed under the Compact 3U lighting system. Two lighting sources had different effects on the morphology and biomass of strawberry, whereas different Compact 3U irradiances virtually did not affect the morphological parameters of strawberry (Fig. 3a). Strawberry plantlets were best at 75 $\mu mol\ m^{-2}s^{-1}$. because of the maximum growth and development. However, for commercial purposes, we recommended the use of Compact 3U light at 45 $\mu mol\ m^{-2}s^{-1}$ for the micropropagation of strawberry because of saving electrical energy and still remaining the relatively good growth and development.

Table 2. Effect of different irradiances of Compact 3U on the *in vitro* development of *Fragaria vesca* cv. "My Da" plantlets after 3 weeks of culture

Irradiance (Compact 3U) ($\mu molm^{-2}s^{-1}$)	Plant height (cm)	Leaf area (mm^2)	Root length (cm)	Plant fresh weight (mg)
Neon (45)	3.7c[x]	40.5d	2.5d	200d
45	4.2b	45.4b	3.5b	250c
60	4.2b	41.4c	3.0c	270a
75	4.4a	50.0a	3.9a	260b

[x] Different letters within a column indicate significant differences ($P = 0.05$) by Duncan's multiple range test.

***Cymbidium* cv. 'Tim Hot'**: The effect of different irradiances of Compact 3U on the *in vitro* growth and development of *Cymbidium* plantlets is shown in Table 3. Data showed that there was no significant difference in root length of plantlets placed under the different lighting systems. However, the plantlets were significantly taller at 60 $\mu molm^{-2}s^{-1}$, with considerably more roots at 45 $\mu molm^{-2}s^{-1}$ as compared to Neon at 45 $\mu molm^{-2}s^{-1}$ (Fig. 3b). Besides, the data indicated that the plantlets placed under the Compact 3U lighting system had a better growth than those under the Neon lighting system. The irradiance in this case did not affect the root growth but plantlet fresh weight, which was highest at 60 $\mu molm^{-2}s^{-1}$. The most suitable irradiance of Compact 3U (60 $\mu molm^{-2}s^{-1}$) for growth and morphology of *Cymbidium*, characterized by long shoots and roots, wide leaves and high fresh weight (Fig. 3b), was also the most appropriate intensity

Table 4. Effect of different irradiances of Compact 3U on the *in vitro* development of *Lilium longiflorum* plantlets after 6 weeks of culture

Irradiance (Compact 3U) ($\mu molm^{-2}s^{-1}$)	Plant height (cm)	Root length (cm)	Leaf area (mm^2)	Number of new formed roots	Number of bulbs	Bulb diameter (mm)	Bulb cluster fresh weight (mg)	Bulb fresh weight (mg)
Neon (45)	9.1c*	2.5c	26.1d	11.1b	1.9a	6.4a	750c	510c
45	11.4a	3.8a	40.3a	10.6c	1.6c	5.5d	810b	480a
60	10.3b	2.1d	30.7b	9.7d	1.8b	5.8c	830b	470b
75	9.1c	3.0b	30.0c	13.1a	2.0a	6.1b	930a	460b

* Different letters within a column indicate significant differences ($P = 0.05$) by Duncan's multiple range test

for inducing vigorous growth of the plantlets transplanted to greenhouse.

Table 3. Effect of different irradiances of Compact 3U on the *in vitro* development of *Cymbidium* cv. "Tim Hot" plantlets after 6 weeks of culture

Irradiance (Compact 3U) ($\mu molm^{-2}s^{-1}$)	Plant height (cm)	Root length (cm)	Leaf width (mm)	Number of roots	Plant fresh weight (mg)
Neon (45)	10.1b[w]	3.0a	4.7b	2.0c	620c
45	10.2b	3.0a	4.8a	2.5a	650b
60	10.9a	3.0a	4.8a	2.3b	740a
75	10.2b	2.6b	4.4c	2.6a	610c

[w] Different letters within a column indicate significant differences ($P = 0.05$) by Duncan's multiple range test.

Lilium longiflorum:The effect of different irradiances of Compact 3U on the *in vitro* growth and development of *L. longiflorum* plantlets is indicated in Table 4 and Fig. 3c. The results suggest that the lighting source as well as its PPFD significantly affected the fresh weight of new bulblet clusters derived from initial bulb scales. These results show that *L. longiflorum* bulb scales could be cultured at 75 $\mu molm^{-2}s^{-1}$ under Compact 3U for multiplying new high quality bulblets and under Neon at 45 $\mu molm^{-2}s^{-1}$ for increasing biomass and producing vigorous bulblets before transplanting to greenhouse. In addition, there was a considerable effect of Compact 3U at 45 $\mu molm^{-2}s^{-1}$ on the *in vitro L. longiflorum* morphology. This might be a result of the increase in red light spectrum associated with a low PPFD of Compact 3U lighting source which played a certain role in increasing plant height and leaf area. On the other hand, the *L. longiflorum* root morphology was not affected by different lighting sources.

Subsequent growth of Cymbidium and Lilium plantlets

Cymbidium* cv. "Tim Hot":* The subsequent growth of Compact 3U-derived *Cymbidium* plantlets in the greenhouse after one and a half months culture under 6h/day supplemental Compact 3U lighting source at night is given in Table 5. The results showed that *Cymbidium* plantlets grown in the greenhouse under supplemental Compact 3U lighting source had better development than those derived from Neon lighting source (except for leaf width) (Fig. $4a_1$, $4a_2$).

Lilium longiflorum: Results in Table 6 show that the development of *Lilium* plantlets when transplanted to greenhouse was affected by different lighting sources and intensities. Neon lighting source-derived plantlets had lower growth (plant height and leaf width) but greater number of leaves and better root length than those derived from the Compact 3U lighting source, which yielded variable results under different irradiances (Fig. $4b_1$, $4b_2$).

In summary, the irradiance of Compact 3U had a positively stimulated impact that affected significantly on the development of these three plants. The Compact 3U lighting source had a positive effect on the plant height, and the plant fresh weight of *Lilium*, *Cymbidium*, the number of strawberry shoots cultured *in vitro* as well as on the root length of strawberry and the number of roots of *Cymbidium* cultured *in vitro*. The results obtained in this study showed that the Compact 3U lighting source affected the morphology of these plants, increased their biomass, and enhanced plantlet growth before transplanting to the greenhouse. Furthermore, this data also showed that different plants adapted differently to different lighting sources, but different irradiances from two lighting sources did not affect root development including root fresh weight, root elongation (except for strawberry) and the number of roots (except for *Cymbidium*) of these plants.

In most cases, different Compact 3U irradiances had no obvious impact on plantlet development as compared to those of Neon light. Different irradiances affected *Lilium* and *Cymbidium* plant height and *Lilium* plant fresh weight. In these plants, a lower intensity gave a higher plant quality. Except for the plant fresh weight of *Lilium* that was enhanced when cultured under Compact 3U at 75 $\mu molm^{-2}s^{-1}$, the remaining cases showed that plantlets developed well under lower intensities (45 or 60 $\mu mol\ m^{-2}s^{-1}$). Consequently, Compact 3U confirmed the positive effect

Table 5. Subsequent growth of Compact 3U-derived *Cymbidium* plantlets in the greenhouse after one and a half months of culture under 6h/day supplemental Compact 3U lighting source

Lighting systems ($\mu molm^{-2}s^{-1}$)		Plant height (cm)	Leaf width (mm)	Number of leaves	Number of roots	Root length (cm)	Plant fresh weight (g)
Neon	45	10.4b[*]	5.8a	4.3c	3.7b	2.9b	1.7b
	45	10.5b	5.5b	4.4c	3.6b	3.3a	1.9a
Compact 3U	60	11.1a	5.4b	4.9a	3.7b	3.2a	1.8a
	75	11.2a	5.2c	4.6b	3.9a	2.9b	1.6b

[*] Different letters within a column indicate significant differences ($P = 0.05$) by Duncan's multiple range test.

Table 6. Subsequent growth of Compact 3U-derived *Lilium* plantlets in the greenhouse after 2 months of culture under 6h/day supplemental Compact 3U lighting source

Lighting systems ($\mu mol\ m^{-2}s^{-1}$)		Plant height (cm)	Bulblet diameter (cm)	Leaf width (mm)	Number of leaves	Number of roots	Root length (cm)	Plant fresh weight (mg)
Neon	45	5.5d[*]	0.72c	4.5d	4.7a	4.0c	0.7c	410c
	45	7.6a	0.77b	6.3a	3.5c	4.0c	5.6a	580a
Compact 3U	60	6.8b	0.72c	6.0b	3.7b	4.5b	1.0b	560a
	75	6.1c	0.83a	5.0c	3.7b	4.7a	0.9b	490b

[*] Different letters within a column indicate significant differences ($P = 0.05$) with the mean separation by Duncan's multiple range test.

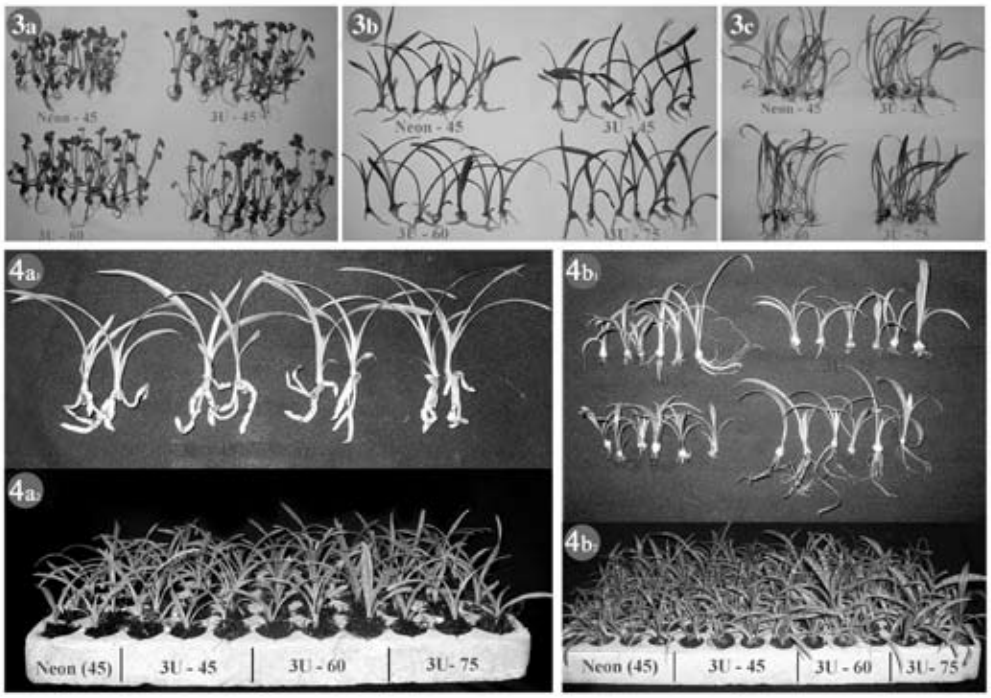

Fig. 3. Strawberry, *Cymbidium* and *Lilium* plantlets cultured under Compact 3U at different irradiances. (a): Strawberry cultured under Neon light at 45 $\mu molm^{-2}s^{-1}$ (top left), Compact 3U at 45 $\mu molm^{-2}s^{-1}$ (top right), 60 $\mu molm^{-2}s^{-1}$ (bottom left), or 75 $\mu molm^{-2}s^{-1}$ (bottom right) after three weeks of culture. (b): *Cymbidium* plantlets cultured under Neon light at 45 $\mu molm^{-2}s^{-1}$ (top left), Compact 3U at 45 $\mu molm^{-2}s^{-1}$ (top right), 60 $\mu molm^{-2}s^{-1}$ (bottom left), or 75 $\mu molm^{-2}s^{-1}$ (bottom right) after six weeks of culture. (c): *Lilium* plantlets cultured under Neon light at 45 $\mu molm^{-2}s^{-1}$ (top left), Compact 3U at 45 $\mu molm^{-2}s^{-1}$ (top right), 60 $\mu molm^{-2}s^{-1}$ (bottom left), or 75 $\mu molm^{-2}s^{-1}$ (bottom right) after six weeks of culture.
Fig. 4. *Cymbidium*, *Lilium* plants after transplanted in greenhouse. (a_1): *Cymbidium* plants transplanted in greenhouse after one and a half months. Left to right: *Cymbidium* plants derived from Neon light at 45 $\mu molm^{-2}s^{-1}$, Compact 3U at 45, 60 or 75 $\mu molm^{-2}s^{-1}$. (a_2): *Cymbidium* plants in spongy tray after one and a half months transplanted in greenhouse. Left to right: *Cymbidium* plants derived from Neon light at 45 $\mu molm^{-2}s^{-1}$, Compact 3U at 45, 60 or 75 $\mu molm^{-2}s^{-1}$. (b_1): *Lilium* plants derived from Neon light at 45 $\mu molm^{-2}s^{-1}$ (bottom left), Compact 3U at 45 $\mu molm^{-2}s^{-1}$ (bottom right), 60 $\mu molm^{-2}s^{-1}$ (top left), or 75 $\mu molm^{-2}s^{-1}$ (top right) after two months in greenhouse. (b_2): *Lilium* plants in spongy tray after two months transplanted in greenhouse. Left to right: *Lilium* plants derived from Neon light at 45 $\mu molm^{-2}s^{-1}$, Compact 3U at 45, 60 or 75 $\mu molm^{-2}s^{-1}$.

on the *in vitro* development of plantlets before transplanting to greenhouse.

These above results were similar to those of Warrington and Michell (1976), Morgan and Smith (1981), Smith (1982), Tibbitts *et al.* (1983), Mortensen and Stromme (1987), Economou and Read (1987), and Agrawal (1992), who all confirmed the significant effects of light quality (related to different lighting sources) on the growth and morphology of *in* and *ex vitro* plants. The effect of irradiance of different lighting sources on the development of plants were also the concern of some studies of Gilslerod and Mortensen (1997), Miyashita *et al.* (1997), and Nhut (2002). In these studies, higher irradiances gave the best plant growth. But in this report, we suggest for use of lower intensities (45 or 60 $\mu molm^{-2}s^{-1}$) of Compact 3U for plant propagation owing to the reduction of electrical energy consumption as well as the increase in the development of some horticultural plants.

The Compact 3U lighting source had a highly significant effect on the development of *Cymbidium* 'Tim Hot', *Lilium longiflorum* and *Fragaria vesca* cv. 'My Da' as in this study. The results indicate that these plants adapted differently with different light sources and intensities. Strawberry shoots had better growth and morphology when cultured under Compact 3U lighting system than those under Neon light system. The preeminence of Compact 3U lighting sytem was also expressed when shoots of three plants were cultured under different irradiances of two lighting system. Though in most cases, different irradiances of Compact 3U had no obvious effect on the development of plantlets as compared to the Neon light, lower irradiance gave higher *Cymbidium* and *Lilium* plantlets quality. Moreover, plantlets derived from Compact 3U lighting system developed better than those from Neon lighting system.

Hence, the Compact 3U lamp, having a suitable light spectrum, resulting in good, high quality plants, saving 75-80% of electrical energy consumption as compared to incandescent lamps, being cheap, and subsequently retrieving initial investments quickly, was expected to be a novel lighting system used in the successful micropropagation and subsequent *ex vitro* growth of some horticultural plants. In fact, because of obvious advantages, the Compact 3U lamp has been used as the lighting source for propagation of many horticulture plants in Dalat, Lam Dong, Vietnam.

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