Utility of a reflector for energy saving in plant tissue and algal culture laboratories

Ravi Kanth Reddy Sathi, Uma Devi Koduru and Akbar Ali Khan Pathan

The present note suggests a power-saving method in plant tissue and algal culture laboratories. Silver-tinted polyester film fixed on all sides of culture racks serves as a reflector of light. The light intensity at the central point in the shelf of the rack lined with the reflector was 8040 lux compared to 3680 lux without a reflector. This improvement is simple, inexpensive and saves 50% electric energy by reducing the number of lights or thin wattage, thus contributing to energy conservation.

Plant tissue and microalgal culture laboratories expend a lot of power to provide the necessary light energy for up to 12 klux in a 16 h/8 h light/dark cycle or even 24 h continuously for culture of some microalgae. Electricity is mostly produced in thermal power projects utilizing coal. Besides depletion of the natural coal resource (energy crisis), it involves release of substantial amounts of carbon dioxide, one of the chief greenhouse gases responsible for global warming and climate change. So, power saving is recommended as one of the steps to mitigate temperature rise on earth[1,2]. We report here a simple power-saving means in culture laboratories to increase light intensity.

Iron racks made of slotted angles with shelves each fitted with fluorescent tube lights are used for placing cultures in many culture laboratories.

The racks in our laboratory have shelves of dimension 120 cm × 37.5 cm × 45 cm (l × b × h). Each shelf is fitted with four fluorescent tube lights (120 cm length 36 W/86 M44, Philips Trulite©). The distance between the lights and the base of the rack is 37.5 cm (Figure 1 *a*).

A silver-tinted polyester film (generally used as a gift wrapper; Rs 4/m^2) was fixed to the shelves on all sides (Figure 1 *b*) to serve as a light reflector. The light intensity was measured at nine different points: A–I (Figure 1 *c*) in the rack with and without (control) reflector. The light intensities recorded at points A–I ranged from 2530 to 3680 lux without the reflector, and from 4820 to 8040 lux with the reflector film (Figure 1 *c*). There was two-fold increase in light intensity in the shelves with the use of the reflector.

Fixing a film with a reflecting glaze to culture racks increased the light intensity in the shelves. The power saving translated to reduction in CO_2 emissions

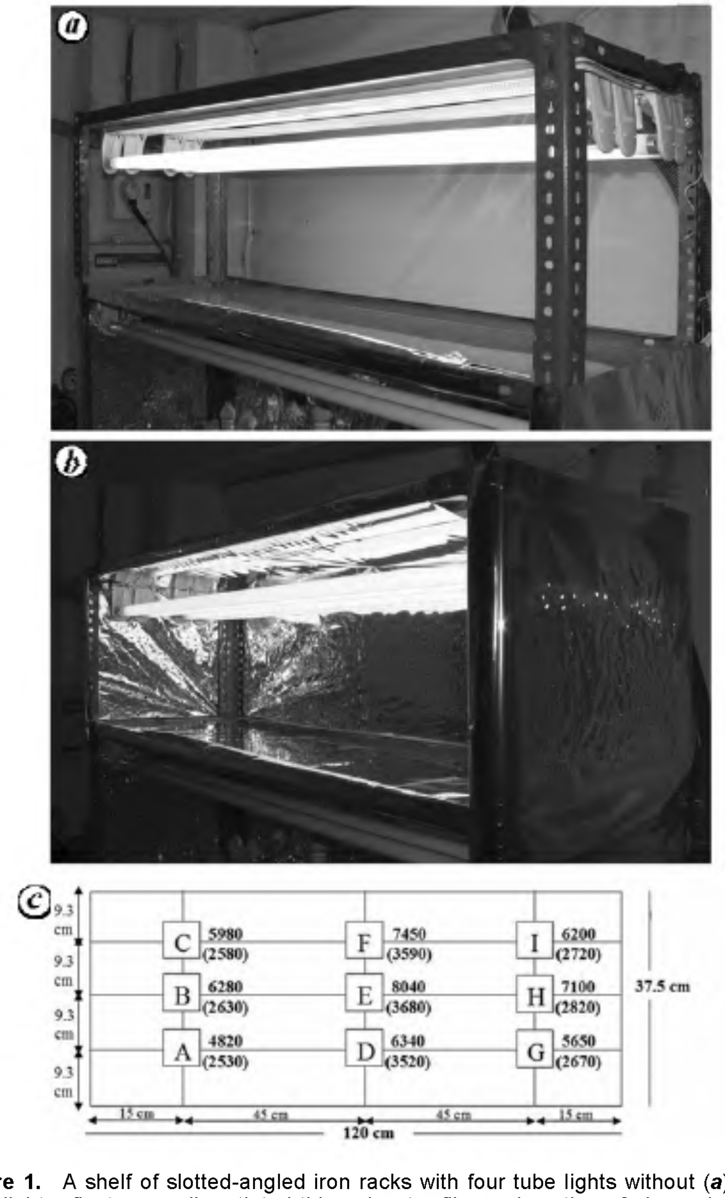

Figure 1. A shelf of slotted-angled iron racks with four tube lights without (***a***) and with (***b***) a light reflector – a silver-tinted thin polyester film. ***c***, Location of nine points: A–I on the bottom plate of the shelf where readings of light intensity were noted. Readings with and without film (in parenthesis) are given at each point. Light intensity was recorded in lux (1 lux = 0.0135 PPF or μmol m^{-2} s^{-1}) with a TES Digital Illuminance Meter TES-1 332 A (TES Electrical Corp., Taiwan). In order to accommodate all the intensities, light readings were taken in the range of 20,000 on the luxometer.

Table 1. Light requirement for culture of some microalgal species

Species	Light requirement (lux)
Tetraselmis chuii	7,400
Dunaliella parva	7,400
Dunaliella tertiolecta	11,100
Isochrysis galbana	10,360
Nitzschia frustulum	6,290
Nitzschia ovalis	10,582
Phaeodactylum tricornutum	11,100
Nitzschia punctata	7,400
Cylindrotheca fusiformis	6,290

can be appreciated with the following assessment. An algal/tissue culture room having four racks with four shelves each and every shelf with four 36 W tube lights and a light/dark cycle of 12 h/12 h consumes 10,313 kWh of power per year. The reflector reduces the power consumption by approximately 50%, i.e. to 5156 kWh. For 1 kWh of power generation from coal[3], 2.095 lb of CO_2 is released. The calculated power saving of 5156 kWh would reduce emission of 10,801.82 lb of CO_2 in a year.

The film used as a light reflector is inexpensive and can be replaced frequently (quarterly). To avoid rise in temperature because of limited air circulation due to fixing of the film to the shelves, small holes were made (with a paper-punching machine) in the reflector paper. There are reports available in the literature about using reflectors for increasing light intensity[4,5], but not such a simple and inexpensive method as the one suggested in our study.

Many of the microalgal species used in our culture laboratory require a light intensity between 8000 and 12,000 lux (Table 1). Light intensity of that range could not be achieved in the shelves even when all the four lights in the rack, and all the lights on the roof and walls of the culture laboratory were switched on. Therefore, the reflector option was tried and has proved successful to achieve the light requirement for microalgal cultures.

1. Pacala, S. and Socolow, R., *Science*, 2004, **305**, 968–972.
2. US Environmental Protection Agency, Washington, Report, 2006.
3. Department of Energy, Environmental Protection Agency, Washington, Report, 2000.
4. Armstrong, J. D., United States Patent 4078169, 7 March 1978.
5. Earnshaw, J., United States Patent 4992917, 12 February 1991.

Received 8 February 2010; accepted 3 August 2010

Ravi Kanth Reddy Sathi and Uma Devi Koduru are in the Department of Botany, Andhra University, Visakhapatnam 530 003, India; Akbar Ali Khan Pathan is in the Department of Biotechnology, GITAM Institute of Technology, GITAM University, Visakhapatnam 530 045, India.*
**e-mail: umadevikoduru@gmail.com*