

# Growth and Photosynthesis of Tropical Forest Tree Seedlings (*Cedrela odorata* L.)

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## 1. Introduction

*Cedrela* genus (family Meliaceae) is restricted to tropical America, from Mexico to Argentina<sup>1)</sup>. *Cedrela odorata* L. is a deciduous tree of straight-cylindrical stem that reaches heights of 30-37m and diameters of more than 1m. The wood, of high quality, is quite used in furniture and drawers. It is also used locally as shade tree in agroforestry systems<sup>2)</sup>. Although wood's physico-mechanical studies are available, essential aspects that effect silvicultural management, such as physiology and ecological requirements, are not well known. Seedling growth is the result of complex, multivariate interactions among environmental variables and seedling physiology<sup>3)</sup>. The following experiments were made to study the growth responses of *C. odorata* seedlings to light availability, nutrients and soil water contents. Also light intensity and gross photosynthesis relations of seedlings growing under different shade conditions were studied.

## 2. Materials and Methods

*Cedrela odorata*'s seeds were collected in a plain moist forest in Bolivia (South America). Seed's mean germination rate, carried out in laboratory, was 86.5%. **Light-Nutrient experiment:** seedlings with the first true leaves fully expanded were transplanted to Wagner's pots (19.5cm long and 17.5cm diam.) in Akahoya soil (B layer). Cabinets (1.6m × 1.6m × 1.4m) covered with black nets were constructed in the nursery of the Miyazaki University Silviculture Laboratory. Sets of 10 seedlings each were placed under the following light availability treatments: I) 100% (full sunlight) II) 60% III) 36% IV) 13% and V) 5%. Each one of these was also subjected to the following nutrient treatment: i) control ii) Level 1st with 5g of NPK (20: 10: 10) iii) Level 2nd with 10g of NPK. **Soil Moisture Content experiment:** the seedlings were transplanted in black vinyl pots (12cm long and 16cm diameter) filled with Akahoya soil. Soil moisture contents were determined using the oven dry weight method at 105°C. Treatments were: I) 67% (pF<sub>0.0</sub>) II) 34% - 40% (pF<sub>1.5</sub> - pF<sub>2.2</sub>) III) 26% - 31% (pF<sub>3.0</sub> - pF<sub>3.7</sub>). In both experiments, measurements of plant height (cm) and plant diameter

(mm) at ground level were done twice a month, during 4 months. Diameter growth, height gain and total seedling growth (D'H) were calculated. Statistical analysis included analysis of variance, F-test and least significant differences, calculated at the 5% probability level. **Photosynthesis determination:** measurement of CO<sub>2</sub> uptake provides an alternative and direct method of measuring productivity and allows separation of photosynthetic gain from respiratory losses<sup>4)</sup>. CO<sub>2</sub> (ppm) assimilation was measured in an infrared gas analyzer. Leaf temperature was 25±1°C. The input relative humidity within the system was 40±3%. Inflow rate of air across the leaf was maintained at 1500ml per min. Light intensity was adjusted to 61, 37, 20, 12, 4.5 and 0 Klx, by interposing nylon mesh filters between the leaf and the projector. Measurements were done on seedlings that showed better leaf expansion (Level 1st of nutrient in each light level). Gross photosynthesis (Pg) was calculated from leaf net photosynthetic rate (Pn) and dark respiration to describe the relationship to light intensity. The parameters "a" and "b" of the equation:  $Pg = bI/(1+aI)$  [mgCO<sub>2</sub> / dm<sup>2</sup>hr]<sup>5)</sup>, using regression analysis of least square, were determined.

## 3. Results and Discussion

**Seedling growth:** variable height growth showed more significantly the effects of nutrient and light. Seedlings had a better height growth using the 1st Level of nutrients. Regarding light, level 13% showed significant differences against 5, 36 and 100% levels. Diameter growth was apparently better to larger quantities of nutrients and light, but significant differences were recognized among levels 5, 60 and 100% only (Fig. 1 and Fig. 2). Seedlings growing at 60 and 100% of light had the best total growth as larger quantities of nutrient were used (Fig. 3). With less light, it seemed to be better at a medium nutrient content than a higher one, in which the growth is small as it was observed for the control group. At light 5%, growth was clearly at a minimum. Soil moisture effect was significant only on height growth for pF<sub>0</sub>, that showed the smallest growth. Total growth under the effect of soil moisture showed the largest growth at pF<sub>1.5</sub> - pF<sub>2.2</sub> and pF<sub>2.4</sub> - pF<sub>2.8</sub> (Fig. 4). **Light intensity and gross photosynthesis relations:** the highest

photosynthetic rate is shown by growing in an open site. These values were similar to values shown by Japan's evergreen trees. Between 13, 36 and 60% of light, there were almost no differences but, at a stronger shade condition, gross photosynthesis was a minimum (Fig. 5). Parameters "a" and "b" increased with lower values of relative light intensity and consequently, saturated photosynthetic rate (b/a) decreased (Table 1). Changes observed in these parameters lead us to think that there was a good leaf adaptation to shading conditions. Likewise, since the seedlings survived even in dark conditions (5% light) we could conclude that *Cedrela odorata* is a shade-tolerant species.

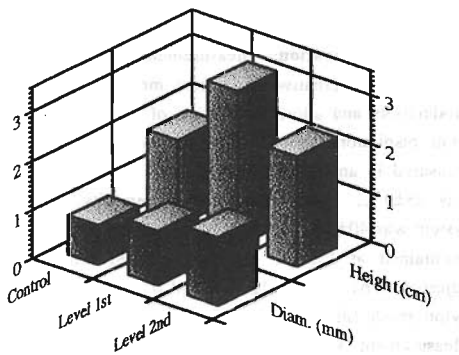


Fig. 1 Nutrient effect on hight-diam. growth

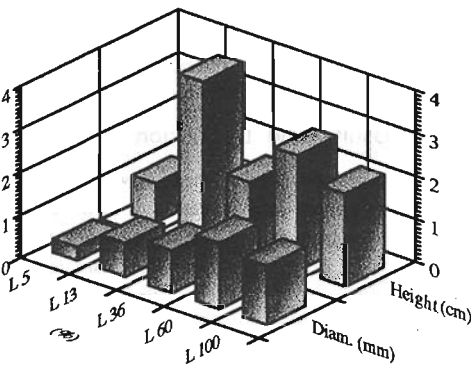


Fig. 2 Light effect on hight-diam. growth

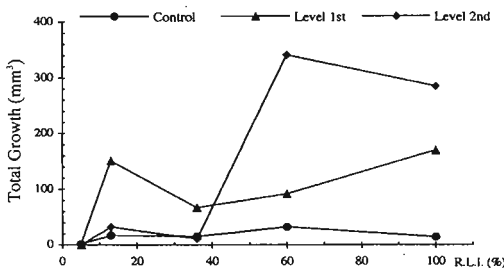


Fig. 3 Nutrient-light effects on total growth (D'H)

#### 4. Reference

- (1) Quevedo, R.C. : Tree Guide of Bolivia, 522-531, 1993.
- (2) Netai Nougyo Kenkyu Center : Useful Tree Species of Tropical Forest, 666 pp, 1977 (in Japanese).
- (3) Elliot, K.J., Vose, J.M. : Tree Physiology, 14, 439-454, 1994.
- (4) Long, S.P., Hallgren, J.E. : Tech. in Bioproductivity and Photosynthesis, 62-94, 1987.
- (5) Yoda, K. : Forest Ecology, 331 pp, 1971 (in Japanese).

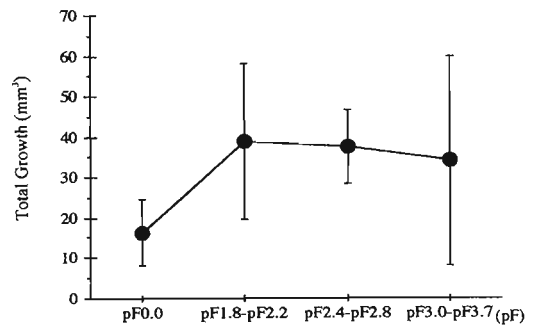


Fig. 4 Soil moisture effect on total growth (D'H)

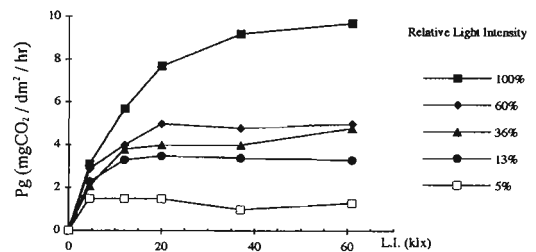


Fig. 5 Light intensity and gross photosynthesis relations

Table 1. Parameters "a" and "b" of gross photosyn. Equat. [Pg = bl/(1+al)] regarding relative light intensity

Parameter	Relative Light Intensity (%)				
	100	60	36	13	5
a	0.053	0.224	0.179	0.369	1.154
b	0.689	1.161	0.916	1.377	1.765
b/a	13.020	5.181	5.115	3.730	1.530