INFLUENCE OF LIGHT AND SUCROSE ON IN VITRO DEVELOPMENT OF SHOOTS IN STYLISMA PICKERINGII VAR. PATTERSONI

Brent E. Wachholder1, Angela J. Kerber1,2, Henry R. Owen1, and Janice M. Coons1

1 Eastern Illinois University, Charleston, IL 61920
2 University of Illinois at Urbana-Champaign, Urbana, IL 61801

Abstract

Seeds were scarified by cutting the blunt end of the seed coat. Seeds were placed in 64 tubes containing 20 ml MS inorganic plus 30g/l sucrose, 100mg/l inositol, and 8g/l agar, pH 5.8. Thirty-two tubes were placed in a growth chamber, while thirty-two tubes were transferred to continuous darkness. Both treatments were inoculated with sterile distilled water. The results showed that seedlings of Stylisma pickeringii var. pattersoni are light-dependent, but are not determined by sucrose concentration. Regression analysis revealed no significant association (p = 0.288) between sucrose concentration and lateral shoot length in plants grown under light (Fig. 3). Regression analysis also showed a stronger (R² = 0.8998) and highly significant (p < 0.0001) positive relationship between hypocotyl plus cotyledon length and sucrose concentration in plants grown in darkness (Fig. 2). Regression analysis revealed no significant association (p = 0.024) between sucrose concentration and lateral shoot length of plants grown under short-day photoperiods. Results also showed that lateral shoot initiation and growth are light-dependent, but are not determined by sucrose concentration.

Results

In the first experimental protocol, there was a complete lack of lateral shoot development in all Stylisma pickeringii plants grown in darkness. All plants kept in the light that germinated and were not discarded as contaminated (57%) had lateral shoots. Regression analysis showed a strong (R² = 0.8998) and highly significant (p < 0.0001) positive relationship between hypocotyl plus cotyledon length and sucrose concentration in plants grown under light treatment (Fig. 1). Regression analysis also showed a stronger (R² = 0.8998) and highly significant (p = 0.024) positive relationship between hypocotyl plus cotyledon length and sucrose concentration in plants grown in darkness (Fig. 2). Regression analysis revealed no significant association (p = 0.024) between sucrose concentration and lateral shoot length of plants grown under short-day photoperiods.

Materials and Methods

Seeds of Stylisma pickeringii var. pattersoni were obtained from a population on private land near Snicarte, Illinois, as part of a previous study (Todd et al., 2002). Seeds were scarified in 2% sodium hypochlorite solution for 30 minutes, and rinsed in sterile distilled water. Seeds were placed into sterile 25mm x 150mm culture tubes containing 20 ml MS inorganics (Murashige and Skoog, 1962), 9 g/l agar (Fisher) and 2 g/l glycine, pH 5.8. Twenty-four tubes of each sucrose concentration were exposed to a 16 hour light/8 hour dark photoperiod (26 µmol/s/m²). Regression analysis revealed no significant association (p = 0.024) between sucrose concentration and lateral shoot length of plants grown under short-day photoperiods. Regression analysis also showed a greater increase in lateral shoot length under long-day (y = 0.524x + 2.58) than under short-day (y = 0.217x – 0.23) photoperiods.

Discussion

Our data strongly suggests that S. pickeringii lateral shoot development is initiated by exposure of the cotyledons to light. This pattern of development is an advantageous adaptation to the sandy prairies bordering major rivers that are the primary habitat of S. pickeringii var. pattersoni. Seeds buried under sand shifted by wind, dust movement, or flooding can promote the energy consuming process of lateral shoot development until the hypocotyl plus cotyledon is at an appropriate length, within 7-8 cm of the seed surface. The linkage between photoperiod and lateral shoot production also would maintain lateral shoot development in summer and reduce development in spring and fall, giving the plant added protection against damage from spring flooding and cold fall and winter temperatures. The exact physiological mechanisms of lateral shoot development remain unclear, but experiments in vitro show that lateral shoots are produced more quickly and with greater vigor under slightly elevated levels of cytokinin (0.1mg/l 6-benzylaminopurine) than in hormone-free media (Fig. 3). Regression analysis also showed a greater increase in lateral shoot length under long-day (y = 0.524x + 2.58) than under short-day (y = 0.217x – 0.23) photoperiods.

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References


Fig. 1: Hypocotyl plus cotyledon lengths of S. pickeringii seedlings grown with increasing sucrose concentrations.

Fig. 2: Hypocotyl plus cotyledon lengths of S. pickeringii seedlings grown at various sucrose concentrations.

Fig. 3: Lateral shoot lengths of S. pickeringii seedlings grown with long and short days at four sucrose concentrations.

Fig. 4: Lateral shoot lengths of S. pickeringii seedlings grown with long and short days at four sucrose concentrations.

Top: Stylisma pickeringii var. pattersoni growing in the wild. ABOVE: P. pickeringii var. pattersoni growing in the black forest. LEFT: The range of P. pickeringii in Illinois (Cook, St. Clair, and Madison counties).