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# Responses of native *Lupinus varius* (L.) to culture conditions: effects of photoperiod and sowing time on growth and flowering characteristics

O. Karaguzel[a,*], I. Baktir[b], S. Cakmakci[c], V. Ortacesme[a], B. Aydinoglu[c], M. Atik[a]

[a]*Department of Landscape Architecture, Faculty of Agriculture, Akdeniz University, 07070 Antalya, Turkey*
[b]*Department of Horticulture, Faculty of Agriculture, Akdeniz University, 07070 Antalya, Turkey*
[c]*Department of Field Crops, Faculty of Agriculture, Akdeniz University, 07070 Antalya, Turkey*

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**Abstract**

The effects of photoperiod and sowing time on growth and flowering characteristics of *Lupinus varius* were investigated during two growing periods to determine its responses to culture conditions as a potential native cut-flower crop. The seeds were sown in an unheated plastic greenhouse on 28 September, 28 October and 28 November under natural, 14- and 16-h day-length treatments. 14- and 16-h day-lengths were established by lengthening the natural day-lengths to 14 and 16 h with the use of night break photoperiodic lighting at 1.8–1.9 $\mu$mol $m^{-2}$ $s^{-1}$ in 400–700 nm. Photoperiodic lighting, in particular the 16-h day-length treatments, slightly (maximally 15 days) shortened days to flowering and increased plant height in all sowing times relative to natural photoperiods. There were no significant differences in stem and branch inflorescence diameters, in lengths of branch, in main and branch inflorescences in plants grown under natural photoperiod, and 16-h day-length treatments. The highest main inflorescence diameter, the number of branches per plant, and flower numbers on main and branch inflorescences were recorded in plants grown under natural photoperiods, whereas 14-h day-length treatments did not provide sufficient specimens to allow for the measurement of most of the characteristics studied. These findings were interpreted to indicate that *L. varius* behaves as a facultative long day plant. Additionally, there was a particular shortening of days to flower and growth, and flowering quality decreased linearly with delayed sowing dates under all photoperiodic treatments. The earliest and latest flowering dates were recorded for plants sown in

* Corresponding author. Tel.: +90 242 310 2478; fax: +90 242 227 4564.
*E-mail address:* okaraguzel@akdeniz.edu.tr (O. Karaguzel).

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September under 16-h day-length, and plants sown in November under natural photoperiods, respectively. Therefore, sowing in September under natural photoperiods or 16-h artificial day-length resulted in earlier flowering dates and a longer time from sowing to flowering and was consequently the best sowing time with respect to all of the characteristics considered in this study.


*Keywords:* Lupinus varius; Day-length; Sowing time; Unheated greenhouse

## 1. Introduction

Market saturation by traditional materials and changes in consumer behaviors have provoked an increasing interest in new floricultural crops, both the form of cultivars or new introductions from wild (Roh and Lawson, 1998; Vonk Noordegraaf, 1998; Heywood, 2003). As a part of general trend, requirements for new cut-flower crops resulted in some *Lupinus* (Leguminosae) species being studied as potential cut-flower crops such as *Lupinus havardii* (Davis et al., 1994; Davis et al., 1995; Mackay et al., 2001), *Lupinus hartwegii* (Cavins and Dole, 2001) and *Lupinus pilosus* (Halevy, 2003) with respect to their inflorescence characteristics and blue flower color.

*Lupinus varius*, a short to medium softly hairy annual, has potential for use as a new cut-flower crop, possessing inflorescences on the main stem and branches with blue flowers that are longer than that of some related species (Blamey and Grey-Wilson, 1998; Burnie, 2000; Karaguzel et al., 2003). However, investigation of its responses to culture conditions and studying the growth and flowering characteristics for their control are needed to evaluate this species as a potential cut-flower crop.

In *Lupinus albus* and *Lupinus angustifolius* cultivars, photoperiod contributes to duration of flowering, and later sowing reduces the duration of the post-initiation phases, particularly the duration of flowering in the field (Reeves et al., 1977). Dracup et al. (1998), Keeve et al. (1999), Keeve et al. (2000) and Christiansen and Jornsgard (2002) have reported that the time to flowering decreased with an increase in the day-length in different cultivars and genotypes of same species under both field conditions and controlled environments. It has been shown for *L. hartwegii* grown for ornamental purposes under greenhouse conditions that the 16-h final photoperiod decreased days to flowering and increased stem length, compared with photoperiods of 8- or 12-h (Cavins and Dole, 2001). While many *Lupinus* species are long-day plants, some species or cultivars can yield different responses to environmental factors with respect to flowering (Pakendorf and Joubert, 1982). For instance, *Lupinus luteus* (cultivar Gol Rush) can easily be flowered under both short- and long-day treatments (Goi et al., 1982) and *L. pilosus* is described as a winter-flowered plant (Halevy, 2003).

As a main part of cultural practice, appropriate sowing dates of lupines can differ due to the latitude, altitude and requirements of species, cultivars or genotypes (Heenan, 1994; Dracup et al., 1998; Keeve et al., 1999). Under Mediterranean climatic conditions, autumn sowings provide greater seed yield than winter sowings in *L. albus* (Lopez-Bellido et al., 1994), and field sowings in early autumn result in the best ornamental value in *L. varius* (Karaguzel et al., 2003).