# The Effect of a Photoperiod on the Flower Bud Development of *Spinacia oleracea* Seedlings Produced Under Artificial Light

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## INTRODUCTION

In general, long days cause spinach plants to develop flower buds, to elongate the stem (i.e., bolt), and to flower, all of which are detrimental to production in summer. In this study, the effect of a photoperiod on the flower bud development of *Spinacia oleracea* L. seedlings produced under artificial lighting conditions, was investigated.

## MATERIALS AND METHODS

Five seeds of *S. oleracea* 'Dimple' were sown in each hole of trays (144 holes per tray, 30 × 60 cm, Taiyo Kogyo Co., Ltd., Japan) filled with granules of rock wool (Taiyo Kogyo Co., Ltd., Japan). They were cultured in three growth chambers (Koitotron 3HN-35MLA, Koito Industries, Ltd., Japan), each had a microwave powered lamp as the lighting source. Photoperiods were 8/16h (Treatment 8H), 12/12h (Treatment 12H), and 16/8h (Treatment 16H), respectively. The photosynthetic photon flux density (PPFD) on the surface of the trays was 350 ±50m mol $m^{-2}$ $s^{-1}$. Temperature and relative humidity in each growth chamber were set at 20C and 70%, respectively. Twenty days after sowing, the seedlings were sampled destructively to examine flower bud development and to determine the maximum leaf length and shoot and root fresh masses.

**Table 1.** Effect of photoperiod on flower bud development of *Spinacia oleracea* seedlings 20 days after sowing.

| | Number of seedlings at each stage of flower bud development | | | |
|---|---|---|---|---|
| Treatment code | No differentiation* | Flower cluster initiation | Flower cluster differentiation | Flower cluster formation |
| 8H | 0 | 4 | 1 | 0 |
| 12H | 0 | 1 | 4 | 0 |
| 16H | 0 | 0 | 0 | 5 |

*Five seedlings were sampled from each treatment.

## RESULTS AND DISCUSSION

In the 8H and 12H treatments, the growing points were between the flower cluster initiation and flower cluster differentiation stages. The flower cluster initiation stage was dominant in treatment 8H and the flower cluster differentiation stage was dominant in treatment 12H. In treatment 16H, aII of the growing points formed flower clusters (Table 1). All of the seedlings bolted in treatment 16H. The leaf length, root length, and shoot fresh mass were not significantly different among the treatments, while the shoot fresh weight and shoot and root dry weight were greater in treatment 16H than those in treatments 8H and 12H.

In conclusion, the short photoperiod treatment retarded flower bud development of *S. oleracea* seedlings. This result could be beneficial when producing seedlings for transplanting, with the aid of artificial light.

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# The Growth and Development of Cut-flower Rose Cultivars in Shoot-Tip Culture

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**The shoot-tip culture and propagation in vitro of roses for cut-flower production was developed in order to test their resistance to crown gall. Terminal buds were taken from the shoots after they had grown 1 cm following flower harvest. These buds grew well and culturing in May was found to be the most suitable season for *Rosa* 'Carl Red'. After the in vitro culturing of 25 cut-flower cultivars, MS medium containing BAP and $GA_3$ was found to give the best results. The most suitable medium for maximum viability, leaf number, lateral shoots, and maximum shoot length was in most cases the same one for a given cultivar.**

## INTRODUCTION

The selection of resistant rose cultivars to crown gall disease by in vivo inoculation has been reported on (Boelema, 1969; Ohta, 1993). However, climate, soil conditions and plant growth affect this method.

Recently, tissue culture techniques have been applied to plant breeding (Toyoda et al., 1989; Isizawa et al., 1992; Chatani et al., 1996).

We have developed an in vitro inoculation method for testing the resistance of roses to crown gall disease (Zhou et al., 1996). For this method, culturing and propagating plant cultivars in vitro is important. Therefore, we have propagated 20 types of rose