TRANSPIRATION AND STOMATAL CONDUCTANCE OF ROSES CV SONIA GROWN WITH SUPPLEMENTAL LIGHTING.

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Abstract

Roses cv Sonia were grown in the winter in a greenhouse with or without supplemental lighting (20 h SON/T; 5 W/m2). The transpiration rate of plants grown with supplemental lighting (SL-plants) was higher than of plants grown without supplemental lighting (NL-plants), both in the light and in the dark period. Stomates of NL-plants closed during the night, while stomates of SL-plants remained open during the 4 hours of darkness. The number of stomates per area was the same for both plants. During the first two days of vase life at 12 h light/day, the transpiration rate on leaf area base of SL-flowers was almost twice that of NL-flowers and stomatal resistance of SL-flowers was lower than that of NL-flowers. Stomates of SL-flowers closed only partial during the dark period in contrast with NL-flowers. When cut flowers were placed in constant darkness transpiration rate of SL-flowers was higher than of NL-flowers and the stomates of SL-flowers remained open during more than 40 hours, while the stomates of NL-flowers closed almost immediately.

1. Introduction

In the Netherlands, for production of roses, the use of supplemental lighting is increasing rapidly. Supplemental lighting results in a higher production during winter time and it increases the visual quality of the flowers. In some vase life experiments at the Dutch flower auctions however, cut roses grown with supplemental lighting showed early wilting of flowers and leaves and the occurrence of bent-neck. These effects are well known of roses with a disturbed water-balance.
There is little knowledge about the effects of supplemental lighting during growth on the keeping-quality of cut flowers. Zieslin and Mor (1990) reported either no difference or a negative effect of supplemental lighting on the vase life of roses and a higher water loss during vase life.
The aim of this study was to describe some aspects of the water balance of roses grown with or without the use of supplemental lighting.

2. Material and methods

Roses, cv Sonia 'Sweet Promise', were grown in a greenhouse in 12 liter containers with commercial peat at a temperature of 20/18°C (day/night), with supplemental lighting (SL-flowers) or under natural light (NL-flowers). The rose-cuttings were planted in September 1988, supplemental lighting was started on 1 november 1988 and the experiments were done in januari 1989. Supplemental lighting was supplied for 20 h/day, from 2.00-22.00h, with SON/T lamps with a light intensity at plant level of 5 W/m^2. Flowers were used in the commercial cutting stage.
Transpiration in the greenhouse was measured by weighing the containers plus plants with the soil surface covered with plastic foil.
When cut roses were used, they were recut under water, stored in water for 3 hours at 5°C for maximal water uptake and then put in the vases with one stem per vase. Vase life experiments were done at 20°C, 60% RH, 12 h light/day 1.5 W/m^2 (TL 84), or in total darkness. Transpiration of cut roses was measured by weighing. After the experiments the total leaf area was measured with an 'Area Measurement System' from Delta-T Devices.
Stomatal diffusive resistance to water vapour was measured with a porometer (MK3, Delta-T Devices) at the abaxial side of the top leaflet of the first fully expanded 5- or 7-leaf under the flower. For calculation of averages, resistances of more than 30 sec/cm were taken as 40 sec/cm.
All transpiration rate and diffusive resistance data are the mean values of 5 plants or flowering stems.
The number of stomata were counted with the use of leaf prints. Silicone rubber (Xantopren, Bayer) was applied on the abaxial side of the top leaflet of the first fully expanded 5- or 7-leaf under the flower. After polymerisation this negative print was peeled off. From this negative print a positive print was made with polystyrene dissolved in toluene by applying a very thin layer on the negative. After drying this positive print could be examined microscopically and stomata were counted on 4 spots of 19 mm^2 (2 per print, 2 prints per leaf).

3. Results

The transpiration rate of plants growing with supplemental lighting was higher than of plants growing in natural light, both during the light and during the dark period (figure 1). Stomates of plants growing in natural light showed a high diffusive resistance during the night, while stomates of plants growing with supplemental lighting remained open during the 4 hour dark period (figure 2).
During the first two days after harvest at 12 h light/day, the transpiration rate of SL-flowers was almost twice that of NL-flowers, both in the light and in de dark period (figure 3). Under these circumstances stomatal resistance of SL-flowers was always lower than that of NL-flowers. Stomates of SL-flowers

closed only partial during the dark period, while the stomates of NL-flowers closed fully in the dark (figure 4).
When cut roses were placed in constant darkness the transpiration rate of SL-flowers was higher than of NL-flowers (figure 5) and the stomates of SL-flowers remained open for more than 40 hours, while the stomates of NL-flowers closed almost immediately and stayed closed (figure 6).
The number of stomates of SL-flowers was 11.9 $\pm$ 3.1 per 0.19 mm^2 and of NL-flowers 11.5 $\pm$ 3.3 (averages of 5 leaves).

4. Discussion

A good water balance is one of the most important factors for a long vase life of cut roses. Supplemental lighting during the growing period in the greenhouse had unexpected effects on this water-balance. It disturbed the normal behaviour of the stomates in darkness and its effects remained long after harvest. Supplemental lighting with SON/T lamps with a short period of darkness each day during the growing period alters the endogenous rhythm of the stomates. Differences in transpiration rate on a leaf area base, found between flowering stems grown with or without supplemental lighting, are unlikely to be the result of differences in the number of stomates. The great differences found in transpiration are even higher on a per stem base, because of the larger leaf area of flowers grown with supplemental lighting. This effects on the water balance can have great influence on the vase life. If problems occur with the availability of water, like vascular blockage by bacteria, roses grown with supplemental lighting will show bent-neck or wilt sooner than roses grown in natural light because of their higher transpiration rate.

References

Zieslin, N., and Mor, Y, 1990. Light on roses. A review. Scientia Horticulturae. 43:1-14.

TRANSPIRATION ET CONDUCTANCE STOMATIQUE DES ROSES CV SONIA CULTIVEES AVEC UN ECLAIREMENT COMPLEMENTAIRE

Résumé

Pendant l'hiver, des roses Sonia ont été cultivées en serre avec ou sans éclairement complémentaire (20 h SON/T; 5 W/m^2). Le taux de transpiration des plantes cultivées avec un éclairement supplémentaire (fleur SL) etait supérieur à celui des plantes cultivées sans éclairement complémentaire (fleurs NL), à la fois pendant la période d'éclairement et la période d'obscurité. Les stomates des fleurs NL se fermaient pendant la nuit, alors que les stomates des fleurs SL restaient ouverts pendant les 4 heures de maintien à l'obscurité. Le nombre de stomates était le même dans les deux catégories de fleurs. Au cours des deux premiers jours de vie en vase, dans une pièce conditionnée (20°C; 60% HR; 12h de lumière, 12h d'obscurité), le taux de transpiration (rapporté à la surface des feuilles) des fleurs SL était presque deux fois plus élevé que celui des fleurs NL. Dans de telles situations la conductance stomatique des fleurs SL étaient inférieure à celle des fleurs NL, et les stomates des fleurs SL ne se fermaient que partiellement pendant la période obscure (12h), contrairement aux fleurs NL. Lorsque les roses coupées étaient placées à l'obscurité continue, le taux de transpiration des fleurs SL était supérieur à celui des fleurs NL, et les stomates des fleurs SL restaient ouverts pendant plus de 40 h alors que ceux des fleurs NL se fermaient presque immédiatement.

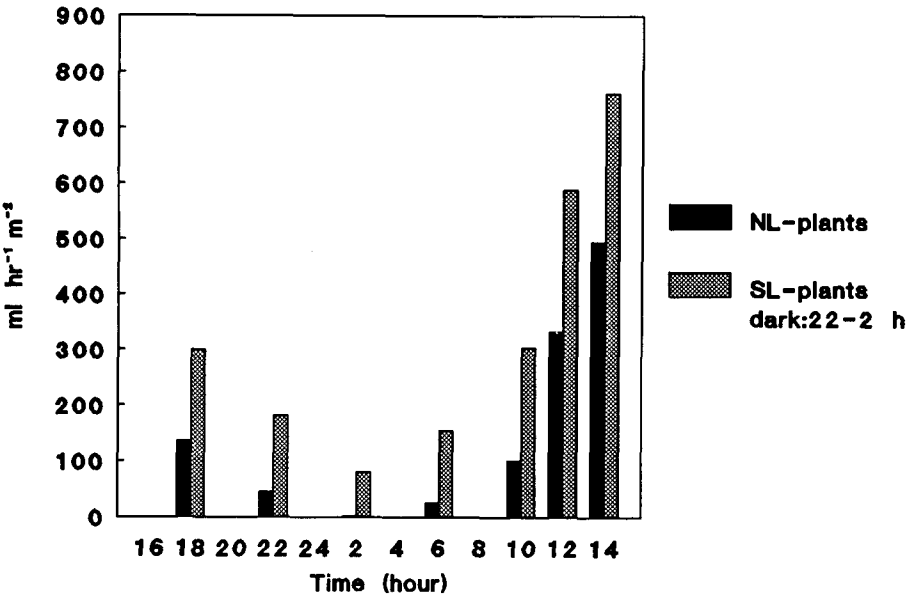

Figure 1 Transpiration rate of plants growing with (SL-plants) or without (NL-plants) supplemental lighting. Bars indicate the average transpiration over the previous period.

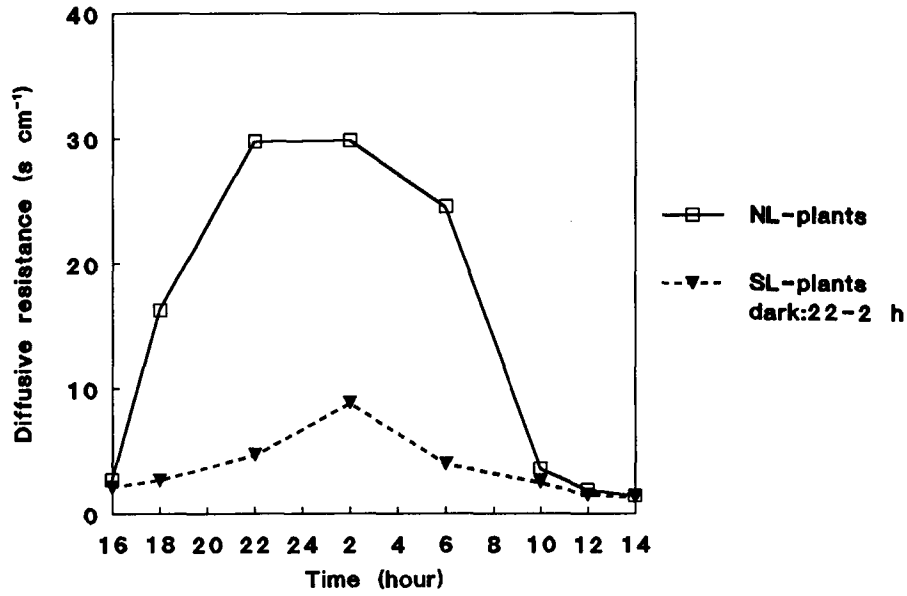

Figure 2 Stomatal diffusive resistance of plants growing with (SL-plants) or without (NL-plants) supplemental lighting.

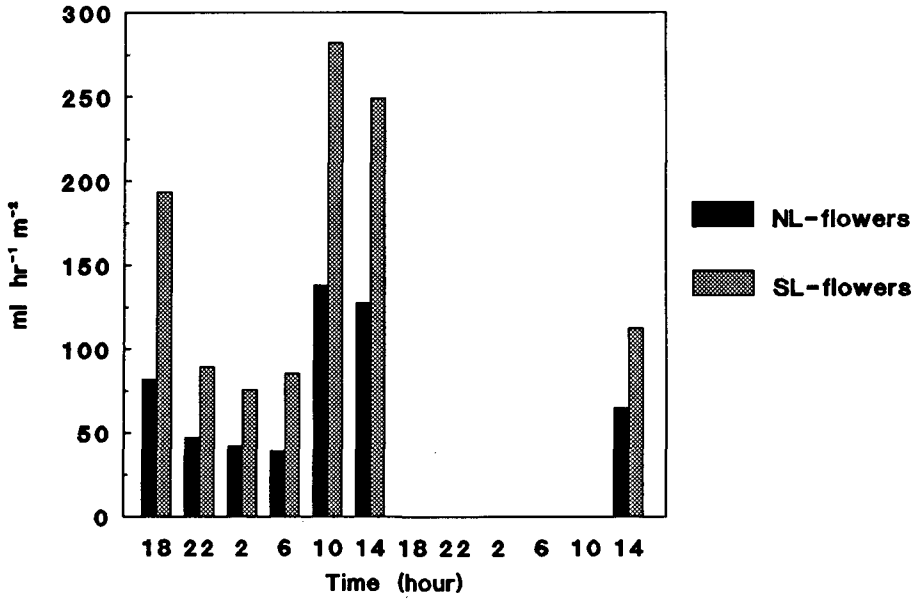

Figure 3 Transpiration rate of cut roses grown with (SL-flowers) or without (NL-flowers) supplemental lighting, placed in the vase at 12 h light/day (6.00-18.00 h). Bars indicate the average transpiration over the previous period.

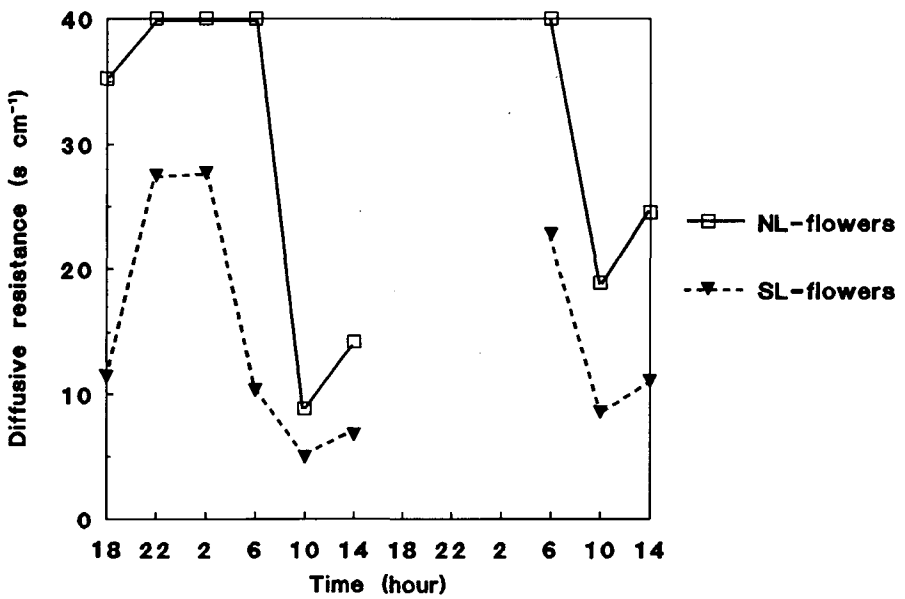

Figure 4 Stomatal diffusive resistance of cut roses grown with (SL-flowers) or without (NL-flowers) supplemental lighting, placed in the vase at 12 h light/day (6.00-18.00 h).

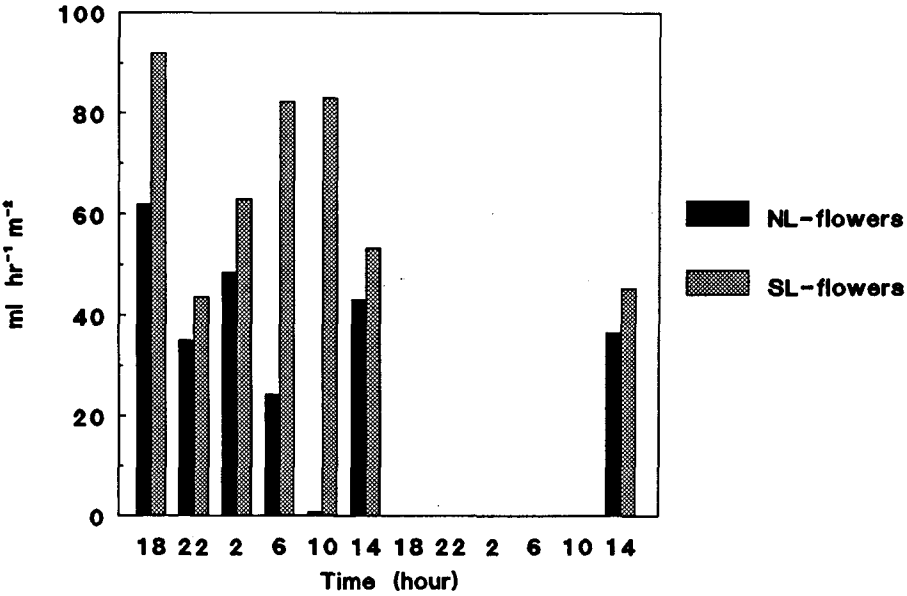

Figure 5 Transpiration rate of cut roses grown with (SL-flowers) or without (NL-flowers) supplemental lighting, placed in the vase in the dark. Bars indicate the average transpiration over the previous period.

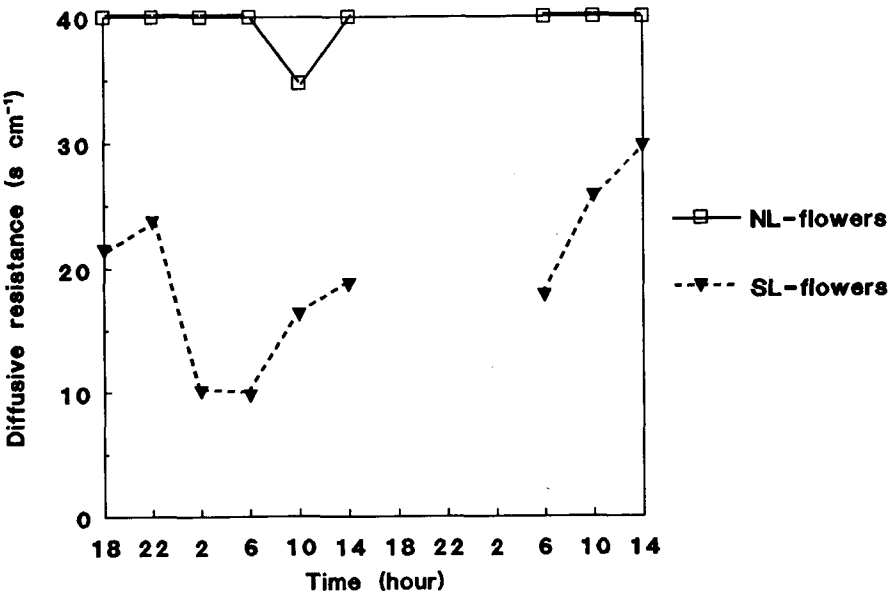

Figure 6 Stomatal diffusive resistance of cut roses grown with (SL-flowers) or without (NL-flowers) supplemental lighting, placed in the vase in the dark.