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ON THE FLOWER INITIATION IN *STREPTOCARPUS NOBILIS* C. B. CLARKE (GESNERIACEAE)

SOBRE A INICIAÇÃO FLORAL EM *STREPTOCARPUS NOBILIS* C.B. CLARKE (GESNERIACEAE)

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SUMMARY

Some data concerning flower initiation in *Streptocarpus nobilis* were obtained. It was found that is possible to induce plants to flower with two short days only, and that the critical photoperiod for floral induction lies between 12:30 and 13:00 hours. Flowering intensity shows a direct relationship to the number of inductive cycles and an inverse relationship to the photoperiod length. Seedlings having only cotyledons could be induced to flower.

RESUMO

Neste trabalho são relatadas diversas características da iniciação floral em *Streptocarpus nobilis*. Foi verificado que é possível induzir-se a floração com apenas dois dias curtos, e que o fotoperíodo crítico para a indução floral localiza-se entre 12 h. 30 min. e 13 horas. A intensidade da floração é diretamente proporcional ao número de ciclos indutores e inversamente proporcional à duração do fotoperíodo indutor. Verificou-se também que plantinhas possuindo apenas os cotilédones são capazes de serem induzidas para a floração.

INTRODUCTION

Streptocarpus nobilis C.B. Clarke is a short day plant from Africa. Rossini and Nitsch (1966) and Rossini (1970) working with leaf discs of this species succeeded in obtaining flower induction and neoformation of floral buds *in vitro*, introducing a new and interesting experimental system to study the flowering process. About the *in vivo* flower initiation in this species only the data from Nitsch's work (1967) are available. Some of the characteristics of flowering process in whole plants are still unknown.

This paper describes some experiments on floral initiation in whole plants, in an attempt to obtain a better knowledge of this species as an experimental system for *in vivo* and *in vitro* studies.

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MATERIAL AND METHODS

Plants were cultivated from seeds in a greenhouse using artificial soil containing vermiculite, sand and vegetable fibers (1: 1: 1). This soil was supplied with Hoagland's nutrient solution (as modified by Went, 1957). Before the photoperiodic treatments the plants were maintained under long days (8 hours sunlight + 10 hours of artificial light by tungsten lamps). The experiments were carried out in part in the greenhouse and dark rooms of the *Instituto de Botânica*, São Paulo (detailed description in Labouriaau, 1969). The temperature was not kept constant, but varied freely between 20°C--35° C. The responses to the treatments were always constant, and ten plants were employed for each treatment, with 7 - 8 leaf pairs each.

RESULTS

Determination of the critical photoperiod for flower initiation

Two experiments were carried out for this purpose. The photoperiods and the results are shown in table I. It can be seen that the critical photoperiod for flower initiation in *Streptocarpus nobilis* lies between 12:30 and 13:00 hours, under the specified experimental conditions. In spite of the fact thal all photoperiods below 12:30 hours lead to flowering, different flowering responses according to different photoperiods were noted. Plants induced under photoperiods of 12:30 or 12:00 hours produced less flowers than those induced by shorter photoperiods (10 or 11 hours of light), and the flower development was slower (Figure 1).

When plants induced by 40 short days (10 or 11 hours of light), were transferred to long days (16 hours of light) the inflorescence axis remained completely reproductive, producing only floral buds, leading to the development of flowers and fruits (Figure 2). On the other hand, plants induced by short days of 12:30 or 12 hours of light (40 days), when transferred to long days, developed vegetative buds and chasmogamic flowers on the inflorescence axis, together with fruits and normal cleistogamic flowers (Figure 3).

Photoperiods of 13 hours did not induce flowering but produced changes in the apical meristems, such as breaking of the vegetative growth and giving rise to abortive floral buds (Figure 4).

Minimal number of short days for flowering induction

This experiment was set up with the aim of determining the minimal number of short photoperiods necessary for flowering. Different groups of vegetative plants were treated with different numbers of short photoperiods (8 hours sunlight) then moved to long days (8 hours sunlight + 10 hours of artificial incandescent light). Results are shown in figure 5. It can be seen that *two* short days are sufficient to promote flowering in all the treated plants, showing the "all-or-none" character of floral induction in this species.

Quantitative aspects of flowering

Two experiments were carried out to demonstrate that the kinetics and intensity -

of the expression of the induced state are dependent on the number of inductive cycles and on the length of the inductive photoperiod.

In a preliminary experiment, plants were induced by a different number of short days (8 hours sunlight), then moved to long days and their floral development compared on the 20th day. The results are shown in figures 6 - 11. The appearance of floral buds and their further development are in direct relationship to the number of inductive short days. Treatments and results of a second experiment are shown in figure 12. It can be seen that flowering intensity is directely related to the number of inductive cycles, and is inversely related to the lenght of the photoperiod.

TABLE 1 – Determination of the critical photoperiod for flowering. Results of two experiments.

DAYLY TREATMENT	% PLANTS FLOWERING (10 plants / treatment)		
photoperiod (hours)	15 days	30 days	45 days
8:00	100^{+}	100^{++}	100^{++}
10:00	100^{+}	100^{++}	100^{++}
11:00	100^{+}	100^{++}	100^{++}
12:00	0	100^{+}	100^{++}
12:30	0	100^{+}	100^{++}
13:00	0	0	0
14:00	0	0	0
15:00	0	0	0

(+) buttons
(++) flowers and fruits
Photoperiod = 6.30 hours of sunlight plus artificial light (tungsten lamps).

Induction of flowering in seedlings and young plants

The minimal age at which these plants could be induced to flower was also studied. Firstly seedlings with only the cotyledons(1) and the first pair of leaves (Figure 13), were placed under short days of 8 hours. After 60 days under these conditions, the plants showed flowers and fruits, with limited vegetative growth (Figure 14). In another experiment, the seeds were germinated under short days, and the plants maintained under these conditions. Twenty-day-old plants with only the cotyledons are shown in figure 15. These plants, when maintained under short days, were able to flower 40 - 50 days after the seeds had germinated, and the vegetative growth was reduced to the cotyledons and the first pair of leaves (Figures 16 and 17).

(1) In this species only one cotyledon grows, the second remains undeveloped.

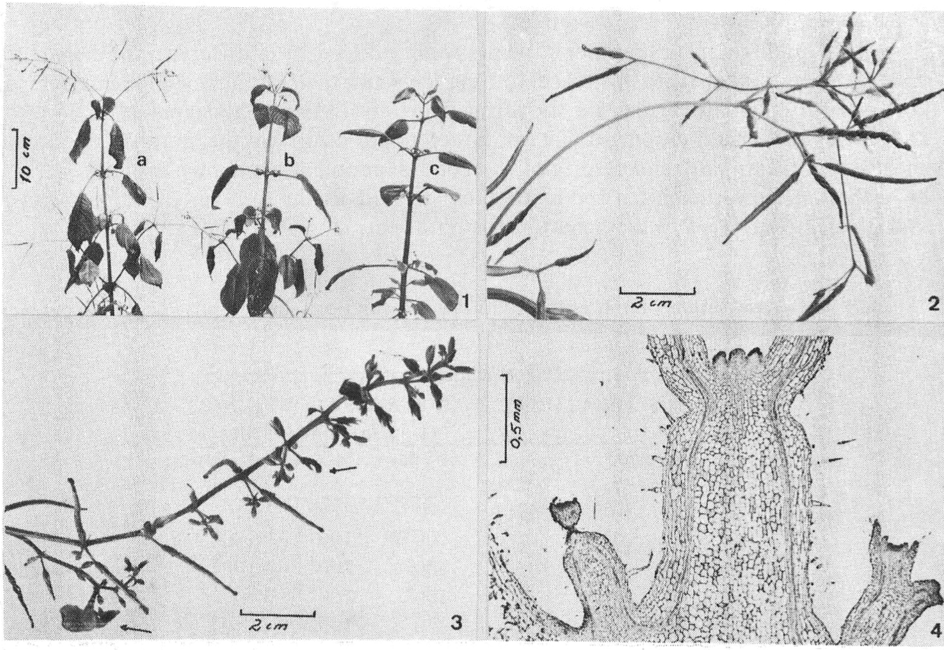


Fig. 1 – Flowering response of plants under different photoperiods after 40 days of treatment. Plant A: 12 hours of light. Plant B: 12:30 hours of light. Plant C: 13 hours of light.

Fig. 2 – Floral branch of a plant induced by photoperiods of 11 hours (40 days), then transferred to long days (photo after 3 months from the onset of induction).

Fig. 3 – Floral branch of a plant induced by photoperiods of 12 hours (40 days), then transferred to long days (photo after 3 months from the onset of induction). Arrows show vegetative buds and chasmogamic flowers.

Fig. 4 – Section through the apex of a plant maintained 3 months under photoperiods of 13 hours.

Fig. 1 – Floração de plantas submetidas a diferentes fotoperíodos, depois de 40 dias de tratamento. Planta 1: 12 horas de luz. Planta B: 12 h 30 min de luz. Planta C: 13 horas de luz.

Fig. 2 – Ramo floral de uma planta induzida por fotoperíodos de 11 horas (40 dias), depois transferida para dias longos (foto depois de 3 meses do início da indução).

Fig. 3 – Ramo floral de uma planta induzida por fotoperíodos de 12 horas (40 dias), depois transferida para dias longos (foto depois de 3 meses do início da indução). As setas indicam gemas vegetativas e flores casmógamas.

Fig. 4 – Corte longitudinal do ápice de uma planta mantida 3 meses em fotoperíodo de 13 horas.

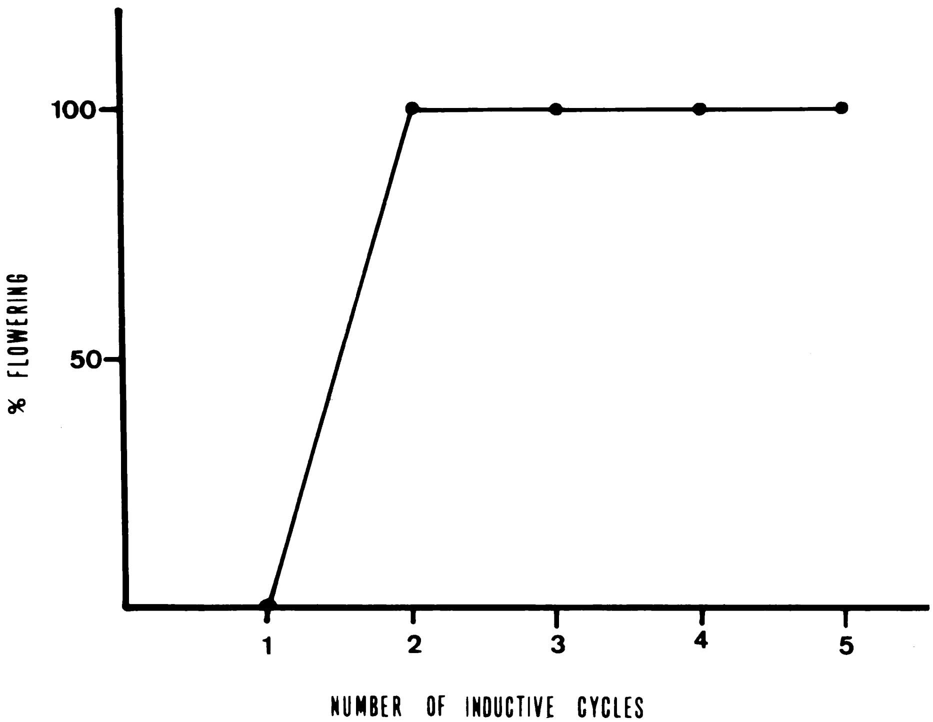
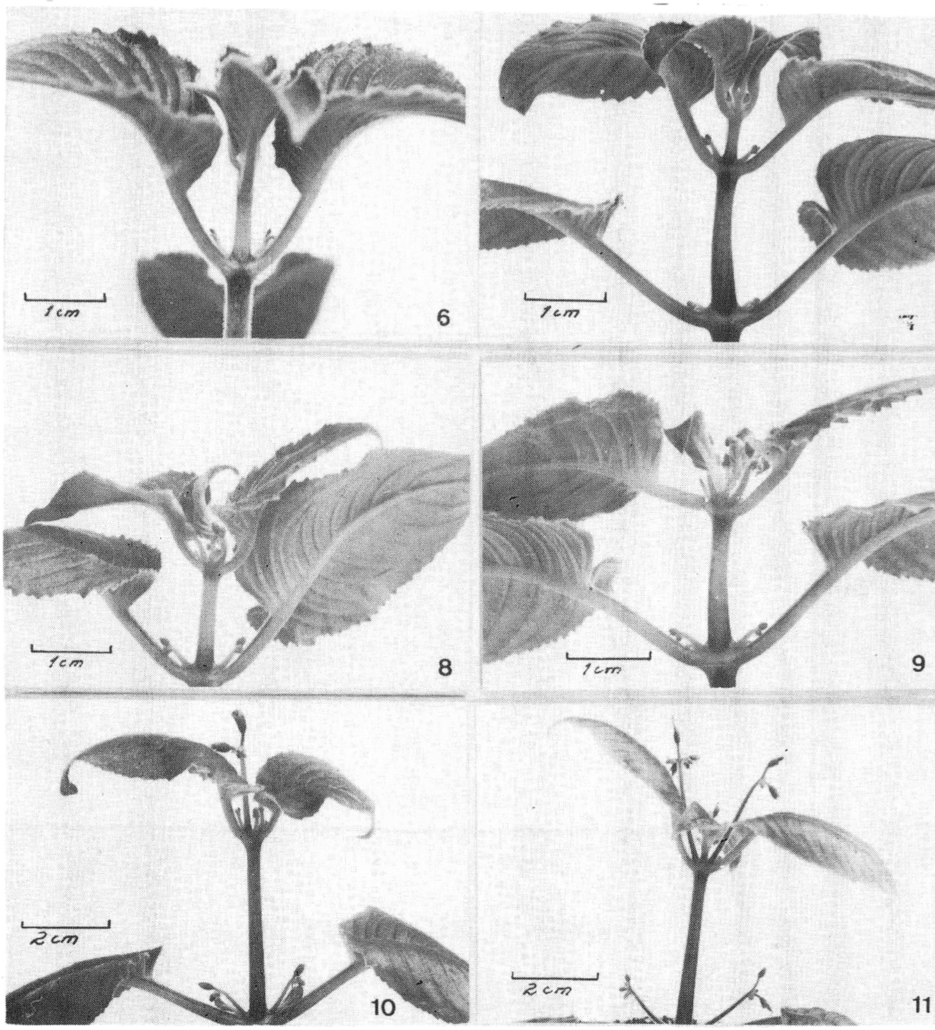


Fig. 5 – Flowering response according to the number of inductive cycles (photoperiod of 8 hours).

Fig. 5 – Floração em relação ao número de ciclos indutores (fotoperíodo de 8 horas)



Figs. 6 - 11–Stages of floral development in plants treated with different number of photoperiods (8 hours of light) compared 20 days after onset of treatments. Fig. 6: long days; fig. 7: 2 short days; fig. 8: 4 short days; fig. 9: 6 short days; fig. 11: 10 short days.

Figs. 6 - 11 – Estágios do desenvolvimeto floral em plantas submetidas a diferentes números de fotoperíodos indutores (8 horas de luz), comparados 20 dias após o início dos tratamentos. Fig. 6: dias longos; fig. 7: 2 dias curtos; fig. 8: 4 dias curtos; fig. 9: 6 dias curtos; fig. 10: 8 dias curtos; fig. 11 10 dias curtos.

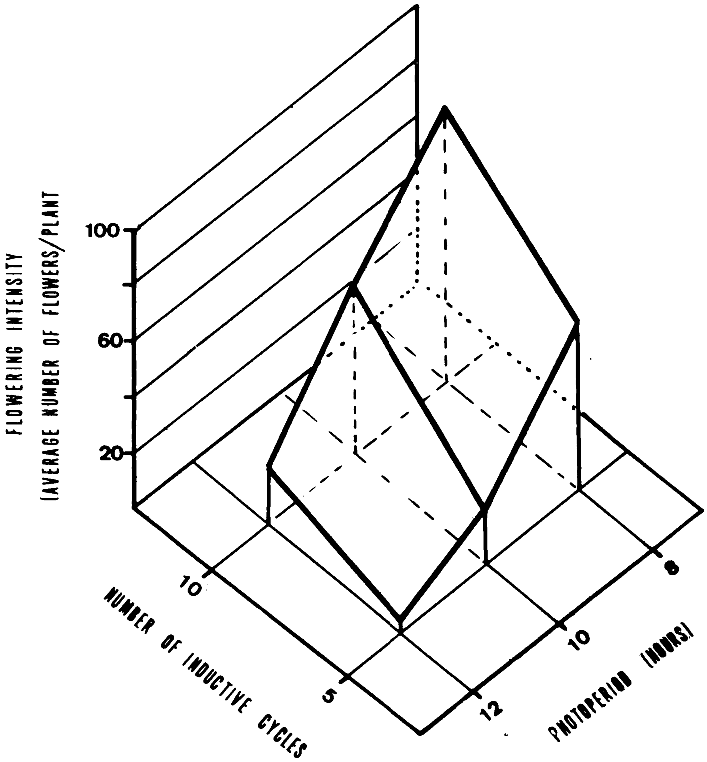


Fig. 12 – Flowering response to the number of inductive cycles and length of photoperiod.

Fig. 12 – Intensidade da floração em relação ao número de ciclos indutores e ao comprimento do fotoperíodo.

Fig. 13 – 30-days-old plant showing the most developed cotyledon.

Fig. 14 – The same plant showed in figure 13, after 60 short photoperiods (the cotyledon was removed).

Fig. 15 – 15-days-old plant growing under short days, showing only the cotyledons.

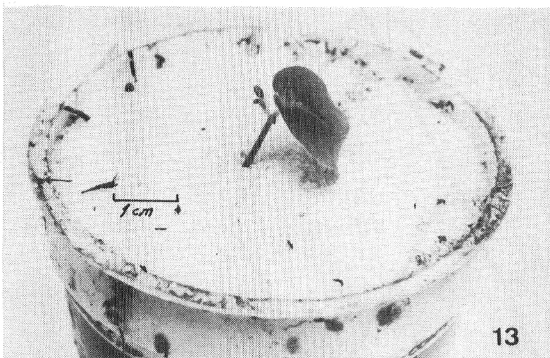
Figs. 16 - 17 – 2-month-old plants cultured under short days. It can be seen the unique difference between the cotyledons (see arrows).

Fig. 13 – Planta com 30 dias de idade, mostrando o cotilédone mais desenvolvido.

Fig. 14 – A mesma planta mostrada na figura 13, após 60 dias curtos (o cotilédone foi removido).

Fig. 15 – Planta de 15 dias de idade crescida sob dias curtos, possuindo apenas os cotilédones.

Fig. 16 - 17 – Plantas de 2 meses de idade, cultivadas sob dias curtos. Vê-se a peculiar diferença entre os cotilédones (veja as setas).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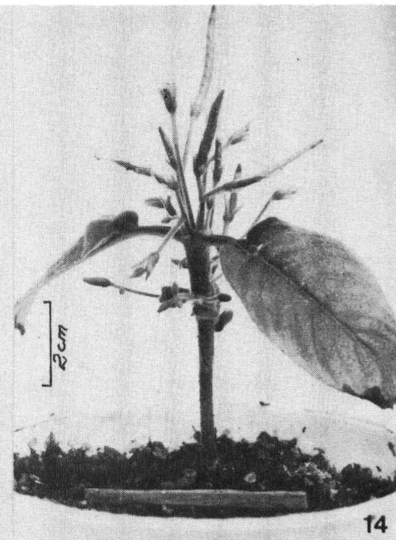
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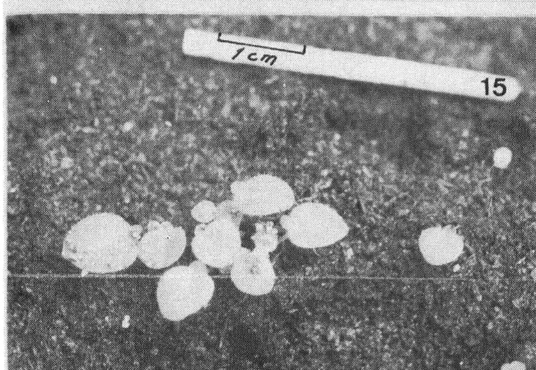
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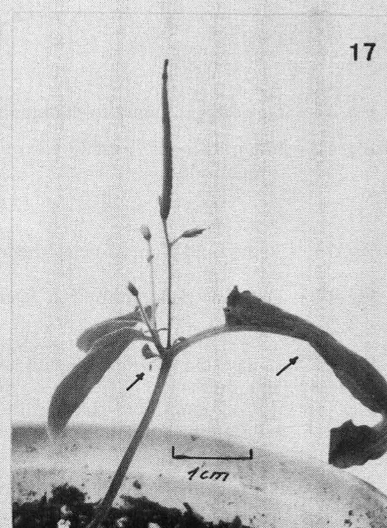
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DISCUSSION

Previous results obtained by Nitsch (1967) with *Streptocarpus nobilis* showed that *four* was the minimal number of inductive cycles needed to produce flowering. In the present work it was found that only *two* short days were required to induce flowering. This result may be due to some physiological differences in the plant material, or differences in the environmental conditions, such as the relatively higher temperatures at which the present experiments were conducted.

The quantitative character of the flower expression under different inductive conditions and the retake of vegetative growth in plants induced by photoperiods near the critical are also noteworthy. It may be that in the latter case, the inductive stimulus is unable to promote the change of all the vegetative meristems towards floral buds. In the case of changes produced by non-inductive photoperiods of 13 hours, it is possible that the photoperiodic stimulus is sufficient to break the vegetative growth and to initiate floral buds, but unable to promote the development of normal floral buds.

An interesting aspect of photoperiodic induction and floral expression in this species is the occurence of chasmogamic flowers. Nitsch (1967) observed that chasmogamic flowers were induced by short photoperiods, when the long night was interrupted by one hour of low-intensity red light. It seems that in this case photoperiodism controls not only floral initiation, but also the further morphogenetic development of the floral buds.

Finally, is should be mentioned that *Streptocarpus nobilis* is able to flower in the early stages of development, the cotyledons showing photoperiodic sensivity, like several species mentioned by Lang (1965).

ACKNOWLEDGEMENTS

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