Effect of photoperiod on seasonal dimorphism of some mediterranean plants

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Effect of photoperiod on seasonal dimorphism of some mediterranean plants

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The seasonal dimorphism in plants of the „phrygana" (ORSHAN 1964); synonyms: garrigue (France), tomillares (Spain), batha (Israel) is a mechanism of adjustment of these plants to the climate of mediterranean areas (mild, rainy winters and dry, hot summers). By means of this seasonal dimorphism the plants reduce their transpiring mass during summer. Till now there is only inadequate information on the mechanism through which the environment affects the growth and form as well as the ways through which their particular form and growth types serve as an adaptation to the environment. In 1938 ORSHAN certified in *Ononis matrix* that the water stress does not determine the changes in the form of leaves and branches at the beginning of the dry period. Also, BERLINER and ORSHAN (1971) experimenting on *Sarcopoterium spinosum* gave results according to which the day length seemed to act on the seasonal dimorphism of the above stated plant. The above work, as well as the fact that more than 20% of the land in Greece is covered by phrygana were the stimuli for the present work in which the seasonal dimorphism is studied in relation to the day length in three basic elements of the phrygana vegetation *(Thymus capitatus, Euphorbia acanthothamnos* and *Sarcopoterium spinosum).*

Material and methods

The collection of the fruits of *Sarcopoterium spinosum (Poterium spinosum* L.) and the seeds of *Thymus capitatus* Hoffmgg. et LK. took place in August and October 1973 in Hymettos area, near Athens. They were planted at the beginning of December 1973 into 1000 ml plastic pots containing a 3:1 mixture of good fertilized soil and sand. In the case of *Euphorbia acanthothamnos* Heldr. and due to the fact that the seeds were impossible to germinate (neither in petri-dishes nor in pots) we used ready seedlings from the same area

aged about one month, which were transplanted into pots. For every plant we used at least 12 pots with 3–5 plants in each one. The pots were placed in growth chambers (Controlled Environments Ltd, Canada, Models EY8VII) under controlled conditions (temperature 20°C until April 15th and then 25°C and relative humidity 70%).

The lighting (08.00–16.00 Hr for the short day (SD) and 08.00–24.00 Hr for the long day (LD) resulted from the combination of fluorescent (General electric F48T12/cw) and incandescent (Osram ooV lamps) and was on the surface of the plants 3400 Lux in LD and 6800 Lux in SD growth chambers (a mixture of 2:3 inc: flu, using a Lux-meter, GURO 7-14/14-18 ϕ). The above difference in the energy is used so that we avoid the case of having different amounts of photosynthesis.

The night break was of a duration of 15 min at the middle of the dark period using inc lamp (OSRAM, ooV) in the SD chamber. The first experiment, with SD and LD conditions only, was finished by June 1974 and the second one, with break on SD plants, was finished by October 1974.

Results

a. Thymus capitatus

Figure 1 shows the plant developed under SD (Fig. 1a), LD (Fig. 1b) conditions as well as a part of a plant we got from natural conditions which show the change of the form which occurs in the nature in June (Fig. 1c). Also, Figure 2 has the details from the above plants. From these Figures and using the life cycle of *Thymus capitatus* (see ORSHAN, 1964, p. 209) is concluded that under LD conditions the plants showed clearly a summer appearance (the winter leaves already shed and the new brachyblasts developed) in contrast to the plants developed under SD conditions.

b. Euphorbia acanthothamnos

Figure 3 shows the life cycle of *E. acanthothamnos.* Figures 4 and 5 show again the results taken. The plants developed under LD conditions also gave the summer form with long lignified internodes.

c. Sarcopoterium spinosum

Figures 6 and 7 show the picture of the plants we got. The results show clearly a summer appearance in the plants under LD conditions. The results taken have already been mentioned in a general aspect by BERLINER and ORSHAN (1971). However a careful observation of the leaves in relation to the work by LITAV and ORSHAN (1971) proves that under LD conditions we have summer leaves while under SD winter leaves.

Night break effect

At the second experiment with *S. spinosum* and *T. capitatus* the use of night break on SD conditions transformed the plants to the summer (LD) form.

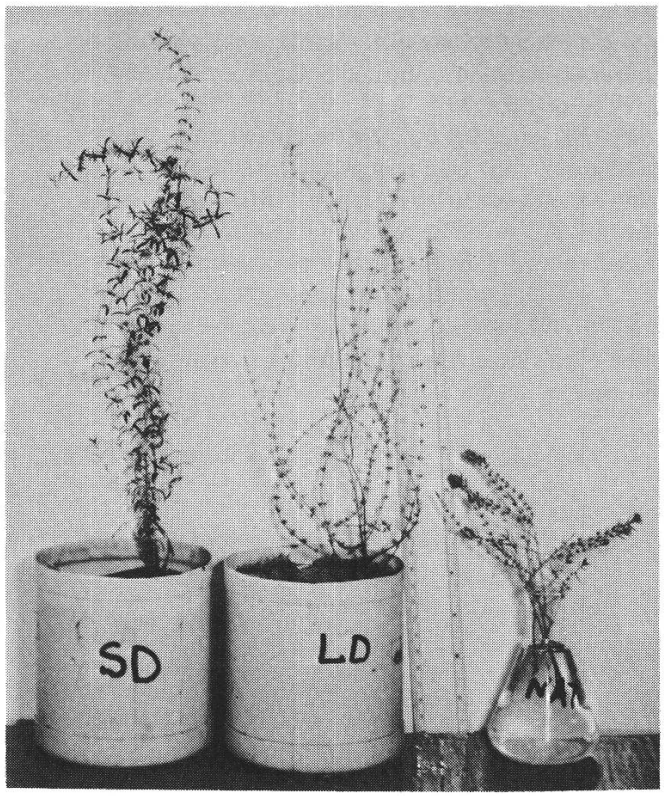

Figure 1:

Thymus capitatus plants developed under short (SD) and long (LD) day conditions. Also, plants taken from nature (NAT).

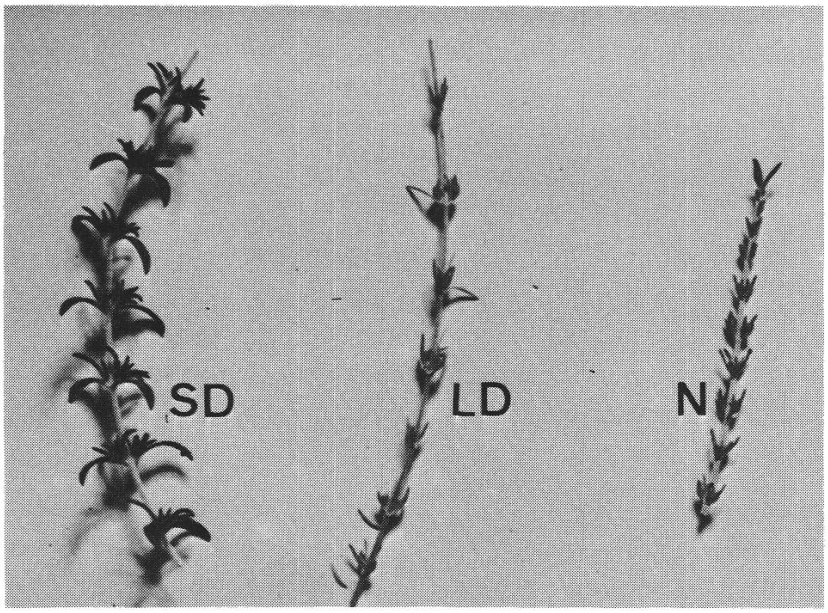

Figure 2:

Branch from *Thymus capitatus* developed under short (SD) and long (LD) day conditions. Also plants taken from nature (N).

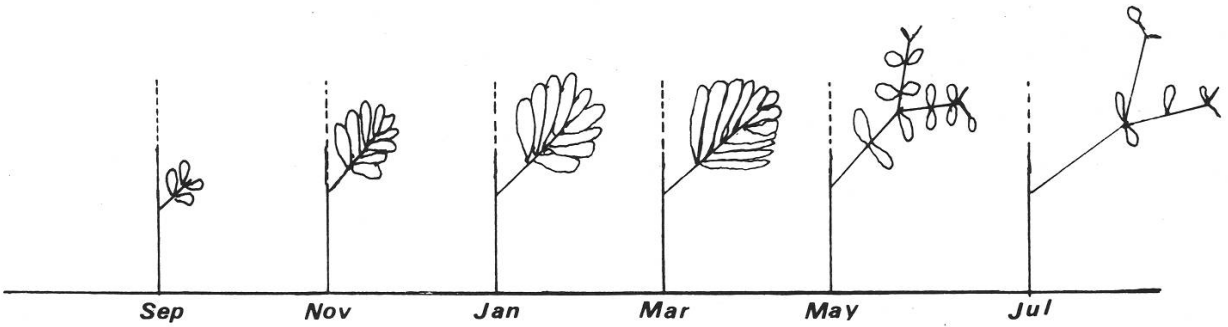

Figure 3: Life cycle of *Euphorbia acanthothamnos.*

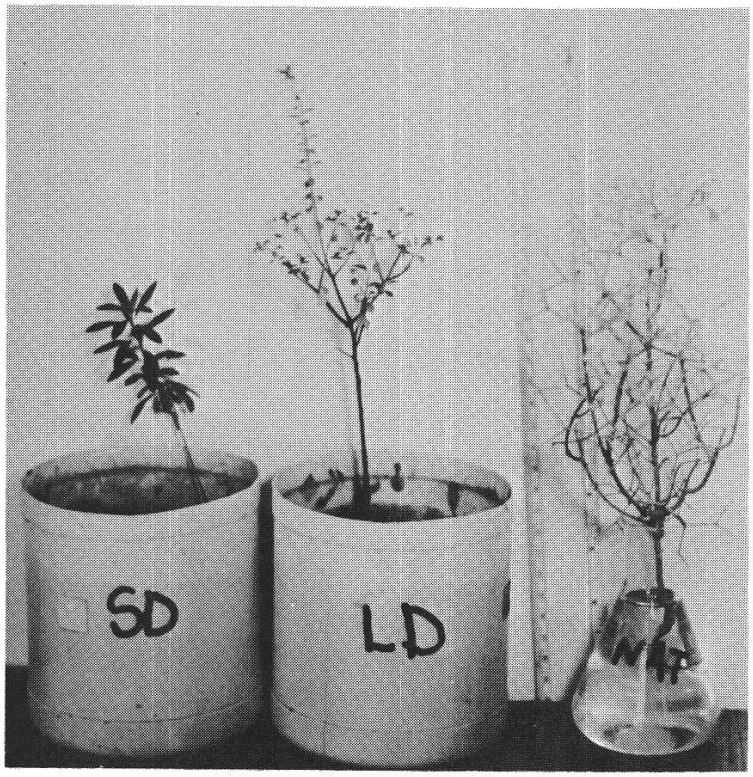

Figure 4:

Euphorbia acanthothamnos plants developed under short (SD) and long (LD) conditions. Also plants taken from nature. (NAT).

Figure 5:

Branches of *Euphorbia acanthothamnos* developed under short (SD) and long (LD) day conditions. Also plants taken from nature (N).

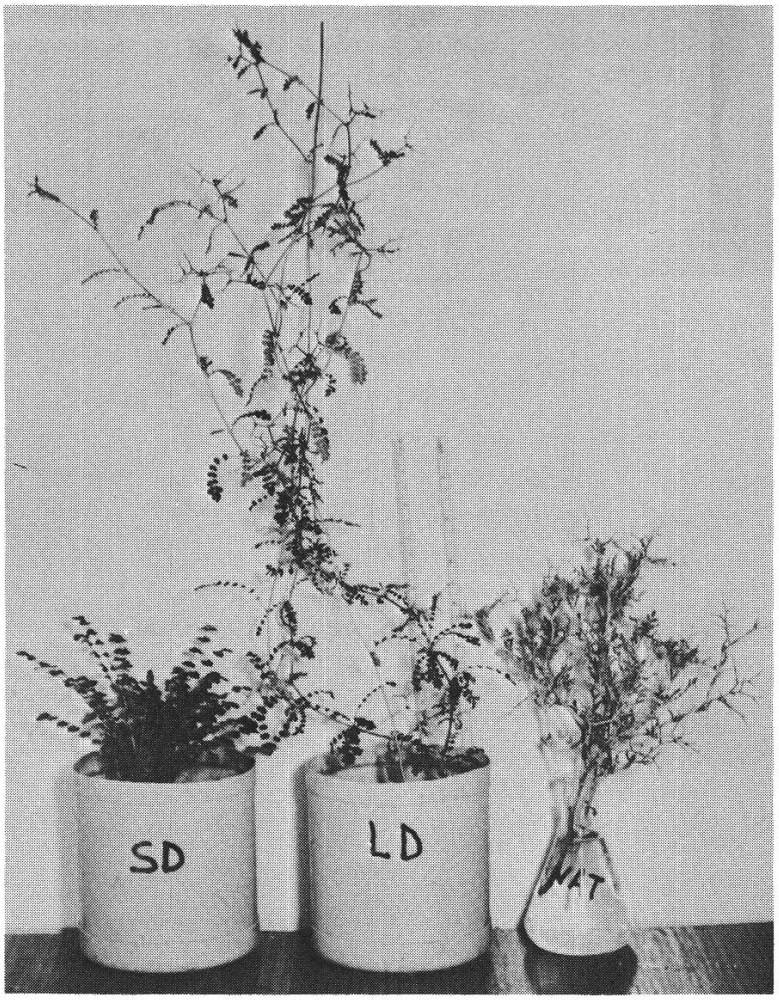

Figure 6:

Sarcopoterium spinosum plants developed under short (SD) and long (LD) day conditions. Also plants taken from nature (NAT).

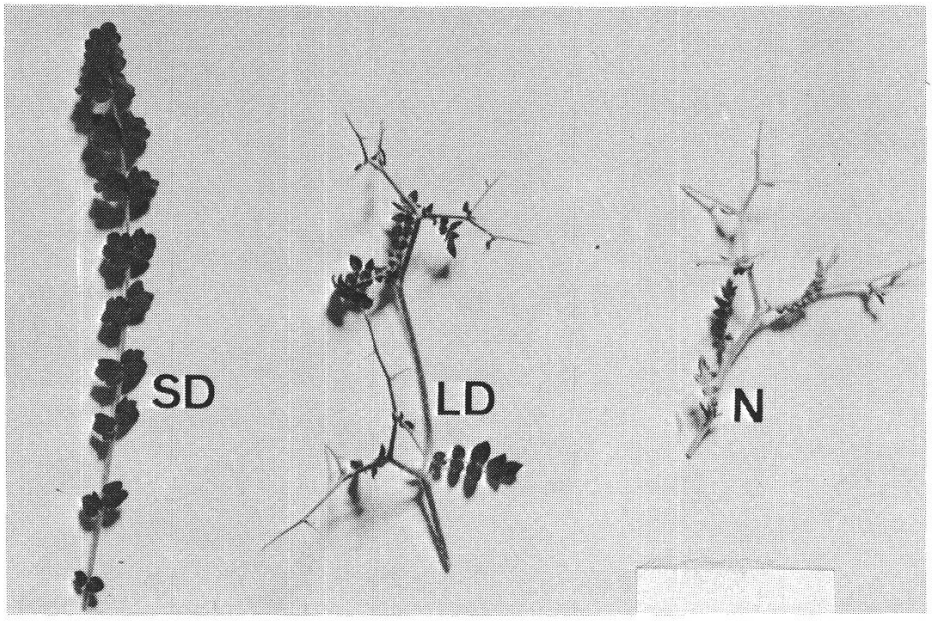

Figure 7:

Branches of *Sarcopoterium spinosum* plants developed under short (SD) and long (LD) day conditions. Also plants taken from nature (N).

Discussion

The seasonal dimorphism, according to the above stated results, seems to be controlled by the day length. Here must be mentioned the fact that the plants developed under LD conditions pass through the winter form to the summer form in contrast to the plants developed under SD conditions which remain in winter form. We think that results are interesting for further study of the mechanism mainly because during the year the plants seem to take more than one signals. We also noticed that in the above mentioned experiments the lighting conditions (8 and 16 hrs for SD and LD respectively) were very different and other combinations must be studied. Also the study of the nature of the photoreceptor (s) is also necessary using different wave-lengths. But as it concerns the photoreceptor involved the results obtained and especially the night break effect permit the development of the hypothesis that this is phytochrome.

The author is most grateful to Mr. J. Argiris and Dr. B. Galatis for their help.

Summary

The seasonal dimorphism of the plants *Thymus capitatus, Euphorbia acanthothamnos* and *Sarcopoterium spinosum* is controlled by the day length and particularly under short day (SD) and long day (LD) conditions a winter or summer form respectively is developed. Using a night break it is possible to obtain the summer form under SD condition.

Zusammenfassung

Einfluss der Photoperiode auf den Saisondimorphismus mediterraner Pflanzen.

Der Saisondimorphismus von *Thymus capitatus, Euphorbia acanthothamnos* und *Sarcopoterium spinosum* wird durch die Tageslänge gesteuert. Unter Kurztagsbedingungen (SD) wird eine Winterform und unter Langtagsbedingungen (LD) eine Sommerform gebildet. Durch kurze Belichtung in der Mitte der Dunkelperiode kann die Sommerform unter Kurztagsbedingungen erhalten werden.

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