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Post Fire Cambial Activity of Two Evergreen Sclerophyllous Species in Greece

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Summary

Cambial activity of post fire resprouted stems of two evergreen sclerophylls *(Quercus coccifera* and *Olea europaea* ssp. *oleaster)* is demonstrated. These resprouters, disregarding the severe climatic problems (particularly drought conditions) which inhibit all growth activities of the same species in the neighbouring unburned area, present increased cambial activity. The high cambial activity is indicated by a wide cambial zone in resprouters while cambial cells are difficult to discern in unburned neighbouring individuals. Besides, pith cells of the latter occupy abundant starch grains, but the absence of starch from resprouters pith cells is evident. This shifts the water problem of the mediterrancan evergreen sclerophylls towards their overground part and gives an indication that these plants can at least withstand fire.

Introduction

It is well documented by now that mediterranean type climate, spread in five areas all over the world (Aschmann 1973, Margaris 1976) supports a certain kind of vegetation which can be either of the evergreen sclerophyllous (maquis) or of the seasonal dimorphic (in Greece: phrygana) type. Great concern has also been given to the stress problems which these formations face, and in particular to the extended severe drought period during summer (Mooney & Dunn 1970; Axelrod 1973; Mitrakos 1980; Margaris 1981). High air temperatures, eliminated air and soil humidity, and dessicated litter are the main factors responsible for the repeated wild fires in this type of ecosystems (Parsons 1976, Naveh 1973). Post fire reactions of the plants indicated that fire has been a strong selective force through evolution and these ecosystems are considered to be „fire adapted" (Jepson 1930; Naveh 1973; Biswell 1974; Arianoutsou-Faraggitaki & Margaris 1981). A thorough investigation has been recently undertaken in Greece where fires, mostly man-made, turned to be a serious problem. Pronounced differences have been pointed out among the leaves of resprouted and unburned seasonal dimorphics in biochemical, anatomical and unultrastructural level (Arianoutsou-Faraggitaki & Margaris 1981; Christodoulakis & Arianoutsou-Faraggitaki unpublished data).

In this paper the cambial activity of burned and resprouted plants of two evergreen sclerophyllous species is studied in order to elucidate the post fire reactions of these plants and compare them to the normal activity of the undisturbed ones in the same area.

Materials and Methods

A couple of weeks after a wild fire on the southern slope of Hymettus, a mountain east of Athens, the new resprouted branches of the evergreen sclerophylls appeared (Fig. A). Disregarding the severe drought, particularly during this season, these resprouters exhibited a tremendous growth potential. Branches from both resprouted and unburned plants of *Olea europaea* ssp. *oleaster* Hoffm. et Link and *Quercus coccifera* L. were collected keeping in mind that they all had

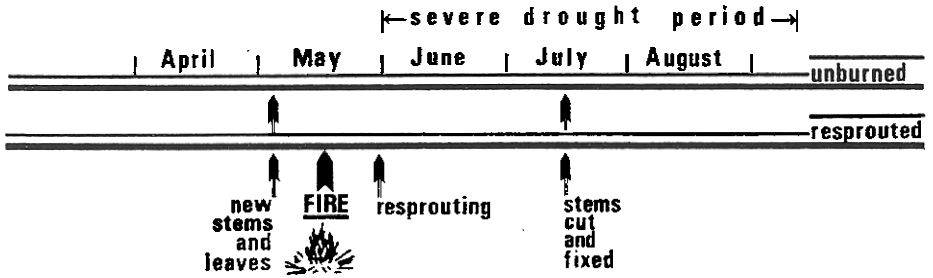

Fig. A. Sampling design of resprouted and unburned stems of *O. europaea* ssp. *oleaster* and *Q coccifera.*

to be of the same age. These branches were fixed in FAA, hand sectioned, stained in toluidine blue O (FEDER & O'BRIEN 1968), mounted in glycerine, and observed under a ZEISS light microscope.

Results and Discussion

In *O. europaea* ssp. *oleaster* the unusual cambial activity produces the extensive growth of the resprouted stems More than four layers of cells give rise to both sieve elements and vessels (Figs. 1,5), while phellogen activity has also been observed (Fig. 5). What is of importance is that at the same time, stems of unburned individuals in the same area do not have any cambial activity at all. Moreover their cambial cells can hardly be seen between phloem and xylem tissue (Figs. 2,6). It is also important that the stems of resprouted individuals cannot afford the accumulation of starch (Figs. 1,5) which in unburned plants can easily be observed in pith cells (Fig. 7).

Q. coccifera presents an identical reaction. The wide, active cambial zone can easily be observed in resprouted stems (Fig.s 3,8) while unburned ones do not seem to grow by that time (Figs. 4, 10). Starch grains can only be observed in ptih cells of unburned plants (Fig. 11-unburned-cf. to Fig. 9-resprouted).

According to our observations the task of a quick recovery after the complete consumption of the overground part by a wild fire seems to be approached with a common reaction in both evergreen species, disregarding the severe drought of the

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Figs. 1, 2. Cross sections of stems from resprouted (Fig. 1) and unburned (Fig. 2) individuals of *Olea europaea* ssp. *oleaster.*

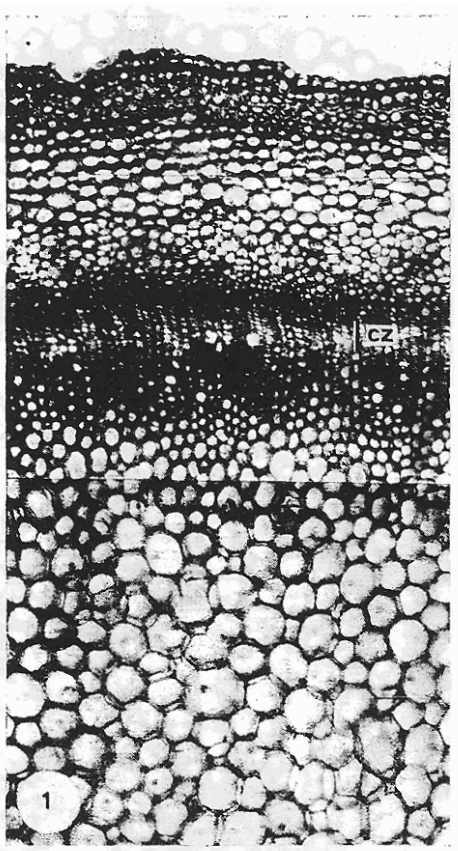
Figs. 3. 4. Cross sections of stems from resprouted (Fig. 3) and from unburned (Fig. 4) individuals of *Quercus coccifera.* All × 80. c = cambium, cz = cambial zone, scl = sclerenchyma.

Figs. 5—7. Cross section of *O. europaea* ssp. *oleaster* stems. Cambial zone (cz) or resprouted plant stems is wide, phellogen divisions can be observed, and pith cells are clear of storage materials (Fig. 5). Cambium is hardly discerned in unburned plant stems (Fig. 6). Pith cells from unburned stems with abundant starch grains (Fig. 7). All × 250.

C = cambium, Col = collenchyma, CZ = cambial zone, F = fibers, P = periderm, Pg = phellogen, Ph = phloem, Pi = pith cells, S = sieve tube, SCL = sclerenchyma, V = vessel, X = xylem.

Figs. 8—11. Cross sections of *Q. coccifera* stems. Cambial zone in resprouted stems is wide (Fig. 8) and pith cells are empty of starch (Fig. 9). Cambium is hardly seen in unburned stems (Fig. 10) while pith cells from unburned stems contain abundant starch grains (Fig. 10). All × 250.

C = cambium, CZ = cambial zone, F = fibers, Scl = sclerenchyma, P = periderm, V = vessel, X = xylem.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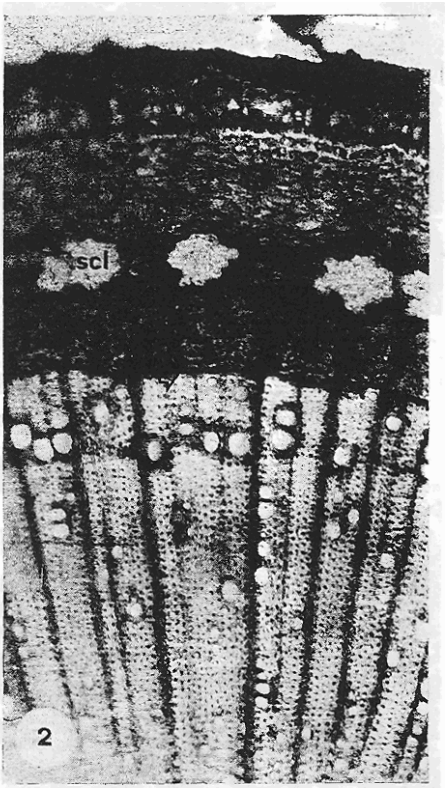
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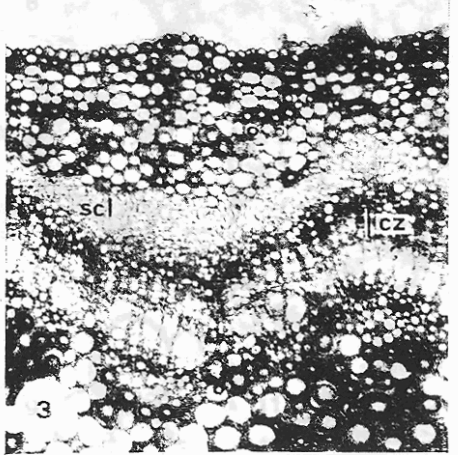
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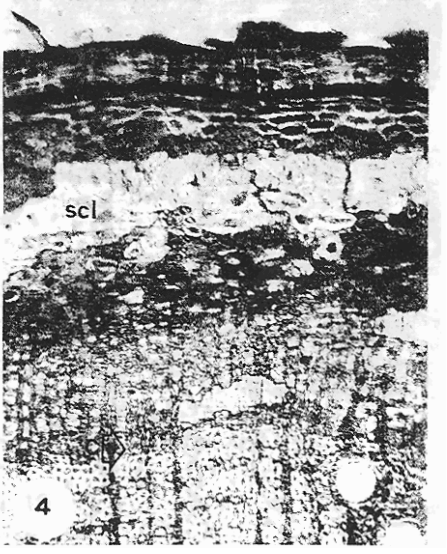
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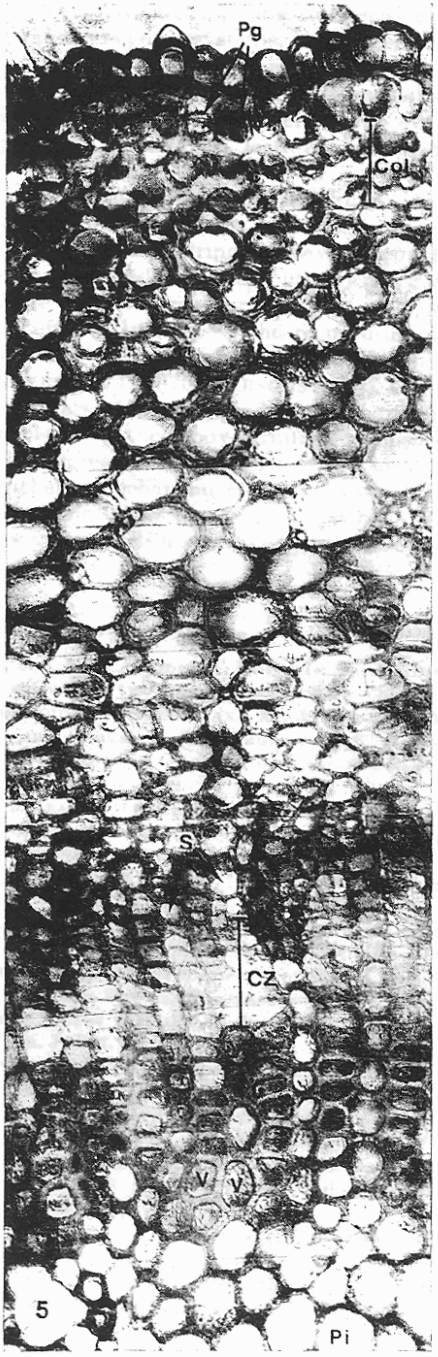
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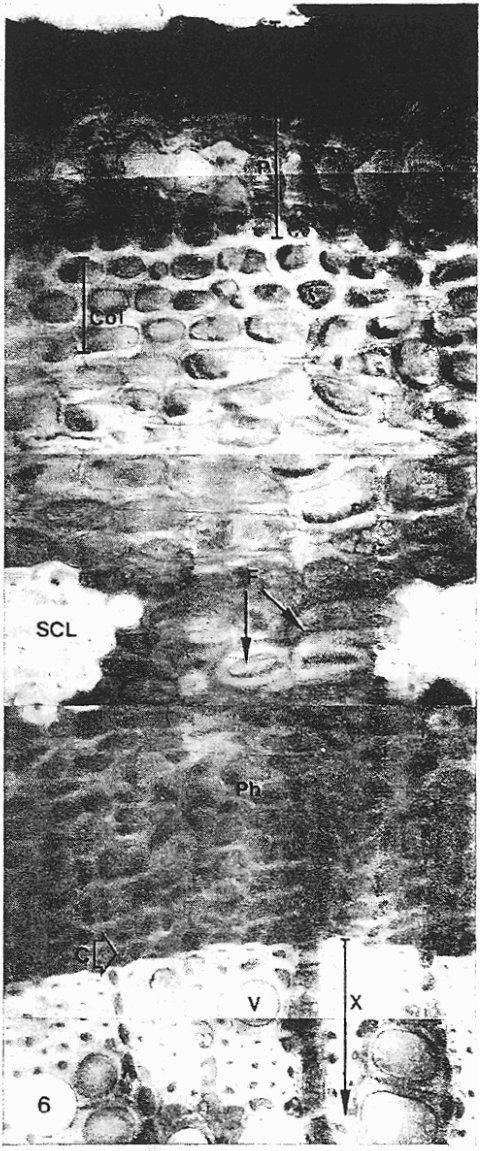
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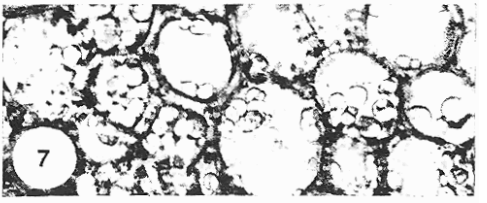
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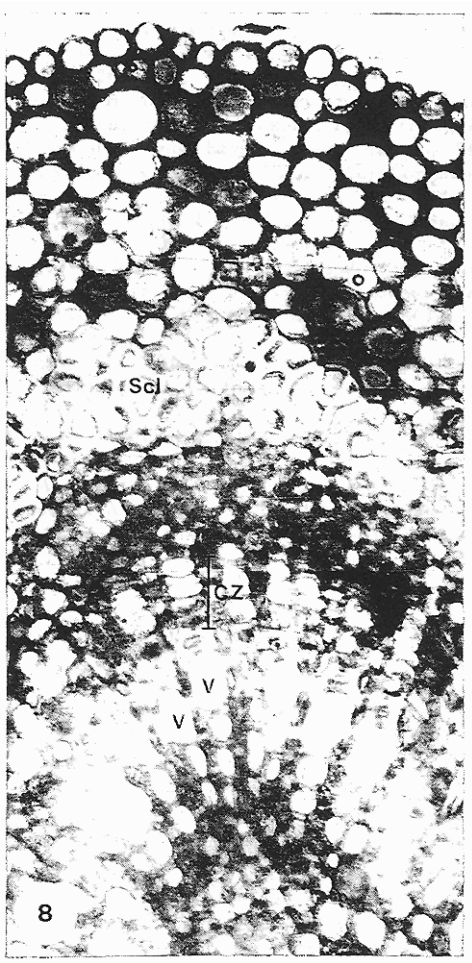

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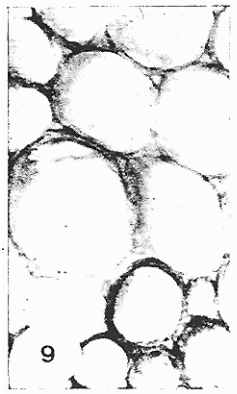

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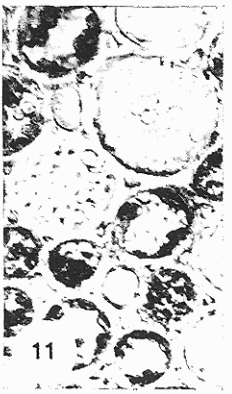

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summer months (Mooney & Dunn 1970), which besides low temperatures of winter (Mitrakos 1980) is among the decisive limiting factors of growth activity in mediterranean type ecosystems. It has been suggested that cambial tissue in mediterranean evergreen sclerophylls seems to be active after the drought summer months, i. e. during the period of the first rainfalls (Arianoutsou-Faraggitaki et al. 1984; Aljaro et al. 1972). Therefore, the evaluation of this recovery reaction of the resprouting plants can lead of interesting conclusions about Mediterranean plant life.

Evergreen sclerophylls are known as deep rooters (Kummerow 1981) that can actually reach water in deeper soil layers and bring it up, but cannot safely operate the water cycle during the severe drought period (Mooney et al. 1974). It has also been suggested that resprouting after a wild fire is favored because of the reduction of the over- to under-ground part ratio, which means that the extensive root system can efficiently support the resprouting and/or because of the tremendous influx of nutrients to the ecosystem, and the elimination of competition among the species (Naveh 1974, 1975; Parsons 1976). Our data provide a strong indication that these plants are if not adapted, at least tolerant to fire, while proofing that their water problem is rather above ground established.

Evergreen sclerophylls respond in a uniform way because the everready photosynthetic mechanism of these plants (Mooney 1981) can now function beyond the forbidding limits of the water problem that the neighbouring plants face during the drought period thus achieving immediate restoration.

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