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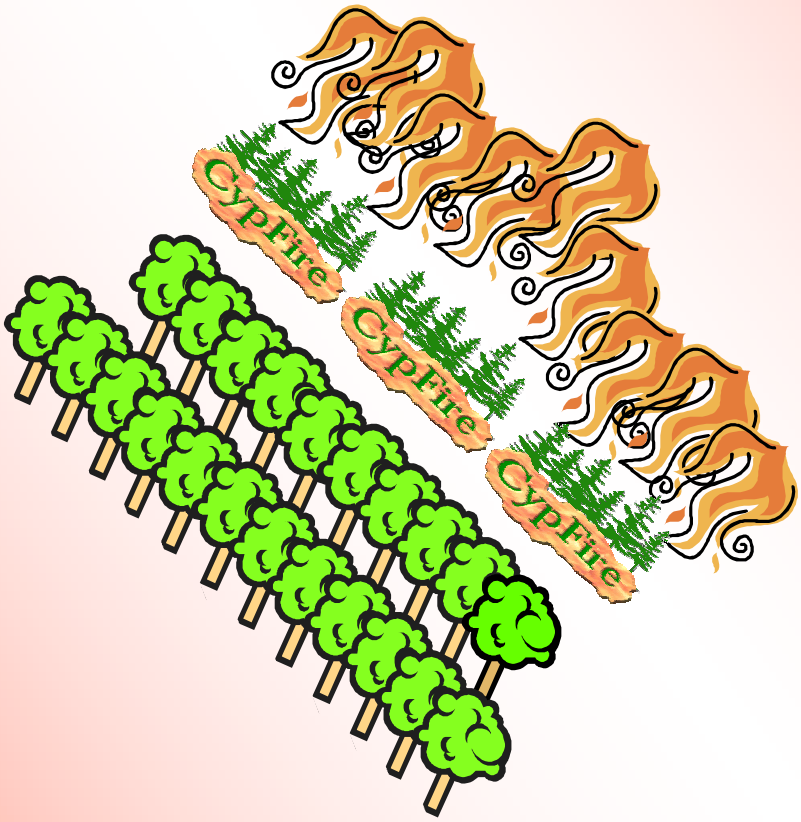
Cypress and forest fires: a practical manual



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Cypress (*Cupressus sempervirens*) and forest fires

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Introduction

Forest fires are a significant hazard in all Mediterranean countries. Although, with the help of research, in the last few decades it has become evident that fire is a natural element of Mediterranean forest ecosystems, the potential for destruction of properties and infrastructures, and even loss of life due to forest fires is real and remains unacceptable for the population that lives close to the forest lands in these countries. As a result, there is a clear need for reducing the potential for large uncontrollable fires which in the last few years have become more common and have resulted in huge disasters (Xanthopoulos 2007).

The reasons for the large fires experienced in the last few years in the Mediterranean countries of Europe are many and complex. Among them, fuel accumulation due to socioeconomic reasons is a prominent one. Fire hazard becomes worse where land use and land cover changes promote an increase in plant biomass (fuel load), such as in the case of abandonment of agricultural lands (e.g. vegetation succession in abandoned farms, pastures or woodlands), and of the horizontal and vertical continuity of the forest fuels. Thus, any effort to mitigate the forest fire problem necessarily has to put an emphasis on the manipulation of forest fuels. From a management perspective, land cover (related to vegetation structure and fuel loads) is the only landscape variable influencing fire behaviour that can be manipulated (Moreira et al. 2011).

Fuel management can be implemented using three main strategies, respectively isolation by fuel breaks, area-wide fuel modification and fuel type conversion (Rigolot et al., 2009). The ways to apply these strategies are many. The work presented here focuses on one of these ways. More specifically it discusses the potential contribution of a native to the Mediterranean region forest species, cypress (*Cupressus sempervirens*), in the frame of such strategies, to the mitigation of the forest fire problem, with special emphasis on Greece.

Cypress and forest fires in Greece

Cypress (*Cupressus sempervirens*) is a forest tree that can become over 25 meters tall. It is a forest species of the Mediterranean basin and has a characteristic form, special characteristics and very good wood quality. In Greece it is planted singly or in groups at religious sites (churches, monasteries) and cemeteries, and for other decorative-aesthetic purposes, but also for other practical reasons such as for hedgerows and for creating windbreaks to protect crops. However, there are also natural cypress forests in many places like the islands of Crete, Samos and Rhodes. An important feature is the impressive adaptation of the species to the Mediterranean climate. It grows in almost

any soil and is tolerant to both frost and drought (Teissier du Cross 1999, Dafis 2010).

In addition to the above uses, in Greece, cypress was planted for many years along the sides of forest roads and fire breaks because it was believed that it can contribute at fire protection. Characteristically, Kontos (1933), discussing fire protection, stated that "... others recommend, especially in the dry land of Attica, (to create) fences and barrages made with pseudo-acacia (*Robinia pseudoacacia)* or with cypress. But in dry Attica, in the Lauretum zone, the acacia tree which is a tree of the Castanetum zone, does not grow on the dry forest soils. Cypress, as well, in order to grow well on the mountains of Attica requires good and relatively wet soil". Stasinopoulos (1975) proposed as one of the silvicultural measures that provide fire protection to "substitute the overstorey by a non-flammable species such as eucalyptus, ailanthus, carob, cypress, etc., preferably in mix of two or more of these species." He also recommended cypress for "... special cases, such as street curbs and in general for the creation of fire resistant and ornamental mantles and of "oases" of variable width or surface ..." where he proposed to create a mix with other ornamental trees and shrubs such as acacias, etc. Also, Kassioumis (1987) suggested, in relation to the introduction of new tree species in forests to break-up the continuity of flammable conifer forests, that in addition to the introduction of broadleaved species "... certain non-flammable coniferous species such as our cypress or the non-native *Cedrus atlantica*, *Cupressus arizonica* var. "*Glabra*" etc. can be used ".

Figure 1. A single row of cypress trees along a forest road in the suburban forest-park of Thessaloniki, Greece, which is a *Pinus brutia* forest created through reforestation in the 1930s.

Figure 2. An unusually wide strip of cypress trees along a fire break in the suburban forest-park of Thessaloniki, Greece,

In practice, following the above views, even before the Second World War, cypress trees were planted along forest roads and fire breaks in many areas in Greece to increase the likelihood of stopping forest fires. As a rule one or few rows were planted (fig. 1 and 2). Over the years these cypress trees grew and were in many cases exposed to fire (fig. 3 and 4). Although occasionally there were some indications that they contributed to fire control, such stories remain anecdotal. No documented evidence, investigation or study ever appeared in literature about such contribution. On the contrary, it became clear many times that a small number of rows of cypress trees did not prevent a fire from passing a road or a fire break (fig. 5 and 6). Furthermore, at times, whole stands of cypress trees were destroyed by fire. Thus, in the period 1964-1988, on the average, 0.386% of the cypress forests in the country, which occupy a total of 6011 ha, burned annually. This percentage is far lower than that of Brute pine (*Pinus brutia*) (1,691%) and Aleppo pine (*Pinus halepensis*) (1,325%) forests for the same period, but it is not trivial. It is also slightly greater than that of black pine (*Pinus nigra*) (0,228%) and deciduous oaks (*Quercus* sp.) (0,223%) which are species growing at a higher elevation and in more moist environment (Kailidis and Xanthopoulos 1991).

Figure 3. A fire in the village of Monastiraki, Sterea Hellas, Greece, that occurred in June 1992. It started among homes and quickly spread in shrubs and the few cypress trees.

Fig. 4. Aleppo pine and cypress trees were exposed to a fast moving early season (June 2001) fire in N. Attica (Xanthopoulos et al. 2004). Nearly all of the pine trees were destroyed, the shrubs burned and regenerated, but most of the cypress trees remained intact.

Figure 5. The fire of Monastiraki seen from a distance. The fire crossed the asphalt road above the village in spite of the (sparse) row of cypress trees.

Figure 6. A fire near Levadia, Viotia, Greece in the mid 1990s. The sparse row of cypress trees did not prevent it from crossing the road. Fire intensity was not great as evidenced by the crowns of the *Pinus halepensis* trees that were not consumed. However, they were completely scorched. On the other hand, the crowns of the cypress trees remained almost intact.

As a result of the non-existence of convincing hard evidence of the contribution of cypress trees in fire control, but also as a side effect of the overall decline in the total area reforested annually by the Forest Service in the last two decades, active planting of cypress trees for fire protection has been practically abandoned.

Can cypress contribute to forest fire control?

In view of the evidence shown from Greece, one or few rows of cypress trees are unlikely to stop a fire from crossing a road or a fire break. However, the relative resistance of cypress crowns to burning is an element indicating that cypress trees may resist fire better than pine trees. Furthermore, the statistics shown from Greece are also an indication that cypress trees are much less flammable than the low elevation Mediterranean pines in Greece, being quite similar in fire resistance to *Pinus nigra* and deciduous and semi-deciduous *Quercus* species which generally require a more moist environment to grow than that of typical, low-elevation Mediterranean lands in Greece.

Apart from the macroscopic observations, experimental studies on cypress flammability have shown that it has longer ignition delay times, both in dry and wet season, than most of 45 Mediterranean vegetation species tested (Neyişçi and Intini 2006). The heat content of cypress branches has been found to be among the lowest (19th) among parts of 22 Mediterranean vegetation species tested by Dimitrakopoulos and Panov (2001). On the other hand, the leaves of cypress had the 3rd highest calorific value among these 22 parts of species. Furthermore, Dimitrakopoulos and Papaioannou (2001) developed regression models between the time-to-ignition and the moisture content values of 24 Mediterranean species in an effort to rank them according to their

relative flammability. They ranked these species in four classes: “less flammable” “moderately flammable”, “flammable” and “extremely flammable”. Cypress was ranked as the least flammable among the 9 species that were ranked as flammable species. In short, these laboratory experiments that focus on small cypress parts, on one hand show that this species is not very flammable but on the other they do not provide strong evidence of special resistance to fire.

At a somewhat larger scale, a small series of test burns in the wind tunnel of the Mediterranean Agronomic Institute of Chania in Crete which compared the ease of ignition of branches of *Pinus halepensis* and *Cypress sempervirens* showed that pine branches positioned above a flame front spreading in pine needles ignited more readily than cypress branches positioned at the same height above the same fire (fig. 7 and 8). Due to the small sample size the data so far cannot support scientific conclusions.

Fig. 7. An experimental setup in the wind tunnel of the Mediterranean Agronomic Institute of Chania to compare the ease of ignition of branches of *Pinus halepensis* and *Cupressus sempervirens* positioned above a flame front spreading in pine needles.

Fig. 8. An experimental fire in pine needles spreading below branches of *Pinus halepensis* and *Cupressus sempervirens* in the wind tunnel of the Mediterranean Agronomic Institute of Chania.

Given the non-conclusive evidence on the flammability of cypress at a small scale the value of cypress in fire prevention should be looked for at a different scale. A careful observer should look at the fuel complex and its overall behavior to fire in order to draw practical conclusions. Neyişçi and Intini (2006) provide some interesting insights in this direction. The litter of cypress, being more compact than that of pine, and as a result drying slower and burning with less intensity, is an important element discouraging fire spread in cypress stands. The dense shade of cypress stands can also discourage shrub growth. Whereas even a single line of cypress trees along a road or around an agricultural field can modify the wind field, a thick stand of cypress trees, including multiple row plantations along roads and fire breaks can do more than that. It may act as an obstacle to short and mid-range spotting of fires, seriously increasing the chances of firefighters to stop a fire there.

Conclusion

In conclusion, cypress is quite likely to be a positive element of the Mediterranean landscape in regard to reducing its natural propensity to burn. However, from the discussion above it can be said that:

Claims of reduced flammability of cypress trees should be made only in a relative sense. This species is quite clearly less flammable than the Mediterranean pines as are various broadleaved species. However, it can grow in typical dry Mediterranean conditions where the hardwoods cannot grow.

A single row of cypress trees along rows and firebreaks is not enough to make a difference in regard to fire control. The wrong assumption that it could offer positive contribution is responsible, to some extent, for the disappointment that came after examples of failures in the past.

Multiple rows of cypress trees along fire breaks are likely to offer significant contributions to fire control. However, before this practice becomes widespread it is needed to investigate all the related parameters quite carefully. The width of the cypress stands, the spacing of planted seedlings and the variant to be preferred (*Cupressus sempervirens* var *horizontalis* with very long and thin branches can contribute much better) in plantations are very important. The width affects the formation of a broad enough strip of compact cypress leaf litter and also leads through its thick shade to a reduced cover and biomass of shrubs. A high crown cover further contributes in this direction. Use of the *horizontalis* variant may also decrease the probability of crowning.

In regard to operational scale creation of plantations of cypress two more things should be considered:

The high susceptibility of cypress to cypress canker which is caused by the fungus *Seiridium cardinale*, should be seriously taken into consideration. All efforts should be made to plant disease resistant cypress trees (*C. sempervirens* var *horizontalis*).

Whatever research effort is currently made in support of incorporating cypress into the fire prevention practices in Mediterranean countries the final results will only become clear after a few decades when a significant number of proper plantations will have been established and come to maturity. As a result, a continuous monitoring program shared by all countries with similar concerns and efforts will be needed in order to establish with confidence a final verdict about how much cypress can help prevent forest fires, at least the “surface” fires.

Bibliography

Dafis, S. 2010. The forests of Greece. Goulandri Museum of Natural History. 192 p. (in Greek).

Kailidis, D., and G. Xanthopoulos. 1991. The forest fire problem in Greece. Aristotelian University of Thessaloniki, Greece, Department of Forestry and Natural Environment, Forest Protection Laboratory. No. 3. 10 p. (in Greek).

Kassioumis, K. 1987. Forest landscape improvement and development of forest recreation areas as means for fire protection, especially in suburban forests. Dasika Chronika. Vol. 1-2: 8-14. (in Greek).

Kontos, P. H. 1933. Against forest fires. Triantafyllou and Co. publishing, Thessaloniki. 40 p. (in Greek).

Moreira, F., O. Viedma, M. Arianoutsou, T. Curt, N. Koutsias, E. Rigolot, A. Barbati, P. Corona, P. Vaz, G. Xanthopoulos, F. Mouillot, E. Bilgili. 2011. Landscape - wildfire interactions in southern Europe: Implications for landscape management. Journal of Environmental Management. 92: 2389-2402.

Neyişçi, T., and M. Intini. 2006. The use of cypress barriers for limiting fires in mediterranean countries. In proceedings of the “Il cipresso e gli incendi” workshop, June 14-16, 2006, Valencia, Spain. Interreg IIIB MEDOCC, Project MedCypre. Florence, Italy: 3-18.

Rigolot, E., Fernandes, P., Rego, F., 2009. Managing wildfire risk: prevention, suppression. In: Birot, Y. (Ed.), Living with Wildfire: What Science Can Tell Us. EFI Discussion Paper, vol. 5. EFI, Joensuu: 50-52.

Stasinopoulos, K. 1975. Contribution to the research on prevention and suppression of forest fires in the prefecture of Attica and in general in the evergreen broadleaved fromation. The Forest. Vol. 69-70 : 23-41. (in Greek).

Teissier du Cross, E. 1999. Introduction. P. 6-8 In: Teissier du Cros E, Ducrey M, Barthélémy D, Pichot C, Giannini R, Raddi P, Roques A, Sales Luis J, Thibaut B, Editors. “Cypress: A Practical handbook”. Studio Leonardo, Florence. 139 p.

Xanthopoulos, G., C. Labris, and C. Golfinos. 2004. The June 4, 2001 fire in the wildland urban interface areas of Northern Attica: Evolution, fire-fighting problems and damages. In Proceedings of the International Workshop on "Forest Fires in the Wildland-Urban Interface and Rural Areas in Europe: an integral planning and management challenge", May 15-16, 2003, Athens, Greece. G. Xanthopoulos editor: 19-28.

Xanthopoulos, G. 2007. Olympic Flames. Wildfire. 16(5):10-18.