

BIOCHEMICAL RESPONSES OF *Pinus pinaster* TREES TO FIRE-INDUCED TRUNK GIRDLING AND CROWN SCORCH: SECONDARY METABOLITES AND PIGMENTS AS NEEDLE CHEMICAL INDICATORS

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Abstract—The biochemical responses to varying levels of localized heat damage to stems and crowns were studied in *Pinus pinaster* trees in Galicia, Spain. The objective was to ascertain the utility of secondary metabolites (total polyphenols, condensed tannins, astringency, free and esterified phenolic acids) and pigments (chlorophylls and carotenoids) as chemical indicators of localized fire damage. The study involved three levels of girdling by trunk heating (0%, 60%, and 75%), three levels of crown scorching (0%, 50%, and 75%), and all combinations of those trunk and crown treatment levels. Secondary metabolites and pigments were analyzed in needles before, during, and up to 8 months after fire treatments. High levels of polyphenols, condensed tannin, and pigments occurred in situations where the sole treatment was 75% crown scorching. Low levels of hydroxycinnamic acids were the result when the treatment was 75% trunk girdling. These responses occurred in the first two months after fire. Thereafter, normal values were observed. Low values of chlorophyll *a/b* ratio and high levels of free protocatechuic and esterified syringic acids were found to be long-term indicators of trunk girdling damage combined with crown scorching.

Key Words—*Pinus pinaster*, fire effects, needles, secondary metabolites, pigments, indicators.

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