The effect of pruning on crown fire behavior in a calabrian pine plantation, northeastern Turkey

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Abstract
Fuel management involves silvicultural interventions that modify fuel properties within a forest stand so that fires propagate slowly through surface fuels at low intensities. Crown fires are more difficult to suppress than surface fires because of their increased spread rate, fireline intensity and rate of perimeter growth. Fire behavior researchers have endeavored to understand the dynamics associated with surface and crown fire interaction for many years. This study focused on the effect of pruning has on crown fire initiation and spread. A total of 24 experimental fires were carried out in a 20-year old calabrian pine (*Pinus brutia* Ten.) plantation in the Meric District, Edirne, northeastern Turkey, in August 2007. The individual burning plots, lying on flat terrain (i.e., 0% slope) were structurally quite homogeneous. Six of the plots were control (i.e., no pruning), and nine plots each were low pruned to 1.0 m and 2.0 m. Canopy bulk densities ranged from 0.13 to 0.38 kg m^{-3}. Each plot measured approximately 0.1 to 0.2 ha in size with the windward edge of the plots being 25 to 35 m in width. Rates of fire spread and fireline intensities ranged from ~2 to 34 m min^{-1} and ~700 to 16 000 kW m^{-1}, respectively. The attendant burning conditions would be regarded as extreme with the Fire Weather Index (FWI) component of the Canadian Forest Fire Weather Index System varying from 29 to 71. Each experimental fire was evaluated individually to understand: (i) the surface-crown fire transition or lack thereof, (ii) the time required for surface fires to initiate crowning, and (iii) the effects of fuel characteristics and weather conditions on the initiation and sustained propagation of crown fire spread. The results were also evaluated collectively to establish relationships between fuel and weather conditions and associated fire behavior characteristics. While the fires in the control or unpruned plots all exhibited active crowning, fires in the low pruned plots displayed both passive and active crown fire behavior with the onset of crowning occurring rather late compared to control plots. Some of the fires in plots pruned to 2.0 m were incapable of any active crown fire development. Passive crowning with moderate rates of spread occurred in plots pruned to 2.0 m even at 10-m open wind speeds of ~24 km h^{-1}. The indications are that surface and crown fuel characteristics together with wind play an important role in the transition of surface fires into canopy fuel layer and the associated crown fire behavior. The results obtained in this study will no doubt be of value in fire and fuel management planning and in predicting fire behavior in calabrian pine plantations in the future.

Keywords: Active crowning**;** Canopy base height; Canopy bulk density; Crown fire initiation; Crown fire spread; Passive crowning.