12 Prescribed Fire in Industrial Pine Plantations

C. DE RONDE[1], J.G. GOLDAMMER[2], D.D. WADE[3], and R.V. SOARES[4]

12.1 Introduction

Industrial plantations of non-indigenous tree species (exotics) can be defined as even-aged stands established outside of their natural habitat. These plantations play a vital economic role in the developing countries of the tropics and subtropics. The ecological benefits of afforestation, however, go far beyond local and regional considerations: the increase in atmospheric CO_2 and its expected negative influence on the global climate may partially be averted through large-scale afforestation with fast-growing species (Maryland 1988). The take-up of carbon in woody matter could potentially balance the discharge of CO_2 from fossil fuel burning and from the vast amount of uncontrolled forest destruction and biomass burning in the tropical and subtropical biota. Although prescribed burning is itself an emission source of CO_2, its main function in plantation management is to increase stability and to protect against destructive wildfires, which are a much larger source. The same is true for particulate matter emissions. Thus, although at first glance it may seem contradictory, prescribed burning is indeed an important link in global fire ecology.

Of the estimated 9,968,000 ha of industrial plantations established in the tropics by the end of 1985, 41% were in softwoods (mainly pines) (Table 1).

Even though almost 60% of the industrial plantations are composed of hardwoods such as eucalypt and teak, most prescribed burning has taken place in pine stands. This chapter will thus be restricted to a discussion of fire in pine plantations. The information needed to plan and safely conduct prescribed fires beneath standing trees (referred to as underburning) and the ecological effects of these fires will be emphasized. The importance of fuel and weather parameters is explained, and techniques of setting fires and monitoring their behavior are described. Some facets of post-harvest burning are also discussed.

The major species used in pine afforestation activities are *Pinus caribaea*, *P. elliottii*, *P. patula*, *P. Pinaster*, *P. radiata*, and *P. taeda*. According to McDonald and Krugman (1986), the leading species are *P. elliottii* and *P. taeda*. They estimate that over 450,000 ha are planted to these two species outside their native

[1]Saasveld Forestry Research Centre, South African Forestry Research Institute, George 6530, South Africa
[2]Department of Forestry, University of Freiburg, 7800 Freiburg, FRG
[3]Southeastern Forest Experiment Station, USDA Forest Service, Dry Branch, Georgia 31020, USA
[4]Department of Forestry, Federal University of Paraná, 80.001 Curitiba, Paraná, Brazil

J. G. Goldammer (ed.), *Fire in the Tropical Biota*

Table 1. Areas of established industrial plantations (in thousand ha) in 76 tropical countries (estimated/projected at the end of 1985). (FAO 1982)

	Hardwood species				Softwood species			
	Other than fast-growing		Fast-growing		Species		All species	
Region	Total	1981–85	Total	1981–85	Total	1981–85	Total	1981–85
Tropical America (23 countries)	183	54	1393	525	2403	832	3979	1411
Tropical Africa (37 countries)	414	121	232	70	673	132	1319	323
Tropical Asia (16 countries)	2137	324	1560	477	973	367	4670	1168
Total (76 countries)	2734 =27%	499	3185 =32%	1072	4049 =41%	1331	9968	2902

range each year. Fire plays a predominant role in the native habitats of all the above species. Because these species have evolved in close association with fire, they have developed adaptations that make them better able to survive frequent fires than are competing woody species. The dynamic ecological equilibrium maintained by fire thus favors development of pine-dominated stands. Furthermore, in most cases exotic plantations are established in fire-prone environments or even in fire ecosystems (e.g., in savannas, grasslands, fynbos etc.). When pines are planted in such areas, attempting to exclude fire is counterproductive. The resulting unnatural accumulation of litter substantially increases the potential of destructive wildfires and retards formation of a herbaceous/woody understory component necessary for ecological stability.

The information presented in this chapter comes mainly from Australia, South Africa, and the United States, where most of these species are extensively planted and where fairly intensive fire research has been carried out. The intentional use of fire to help manage these plantations is perhaps exemplified in the southern United States, where over 1.5 million hectares of southern pine are treated with prescribed fire each year (Wade and Lunsford 1989). Prescribed burning experiments have been carried out in many tropical and subtropical countries including Bahamas, Belize, Brazil, Costa Rica, Fiji, Honduras, Nicaragua, Panama, Spain, and Venezuela, but there are few instances where the practice is currently operational (e.g., Fahnestock et al. 1987; Munro 1966; Vega et al. 1983). Nonetheless, these studies have in many cases demonstrated that prescribed fire can be safely and effectively used in industrial plantations. Used under the wrong conditions, however, prescription fire can destroy the very resource it was intended to protect, and there are trade-offs associated with every fire that should be recognized and carefully weighed before a decision is made regarding the use of fire. This does not mean, however, that its use should be summarily dismissed.