PLANT PHYSIOLOGICAL RESPONSES TO DIFFERENT TYPES OF SMOKE

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AIM: TO ANALYSE THE EFFECT OF SMOKE FROM DIFFERENT FUEL TYPES ON AGRICULTURAL AND NATIVE PLANT PHYSIOLOGY

Introduction

In the first decade of this century Australia has endured a long drought period, which resulted in an increase in bushfires and a subsequent increase in smoke. This increase in smoke has emerged as a major risk for agricultural industries. For example, wineries have experienced financial losses due to smoke taint in wine. The effect of different smoke types on grapevines and on other agricultural and native species is relatively unknown. Studies on smoke taint in wine have primarily used straw as a fuel type which is composed primarily of cellulose. We do not know how smoke produced from combustion of straw reflects that produced from burning other fuel types such as wood, which is composed of lignin.

European olive during 15 minutes of bag and bag + smoke exposure

Waratah Starfire leaf after 15 minute of grass smoke exposure

Fuel burning in mass-loss cone calorimeter

Method

Leaf gas exchange such as photosynthesis and stomatal conductance was measured before and after exposure to different types of smoke. By using a mass-loss cone calorimeter carbon monoxide (CO) and carbon dioxide (CO_2) were measured of the different fuel types.

- Three different species: *Telopea speciosissima* var. Starfire (Waratah Starfire), Citrus Valencia (Valencia Orange) and *Olea europeae* (European Olive).
- Five different fuel types*: Eucalyptus saligna* leaves, forest litter, *Pinus radiata* needles, mixture of native and exotic grasses, straw.
- Three treatments: 15 min in heat proof bag (Bag), 15 min smoke exposure in a heat proof bag (Smoke) and no bag and no exposure to smoke (Control).
- Measurement of leaf gas exchange at five time intervals using the Licor-6400: one measurement before and four measurements after exposure to smoke.

Results

Figure 1: Photosynthesis of Valencia Orange before and after different types of smoke exposure

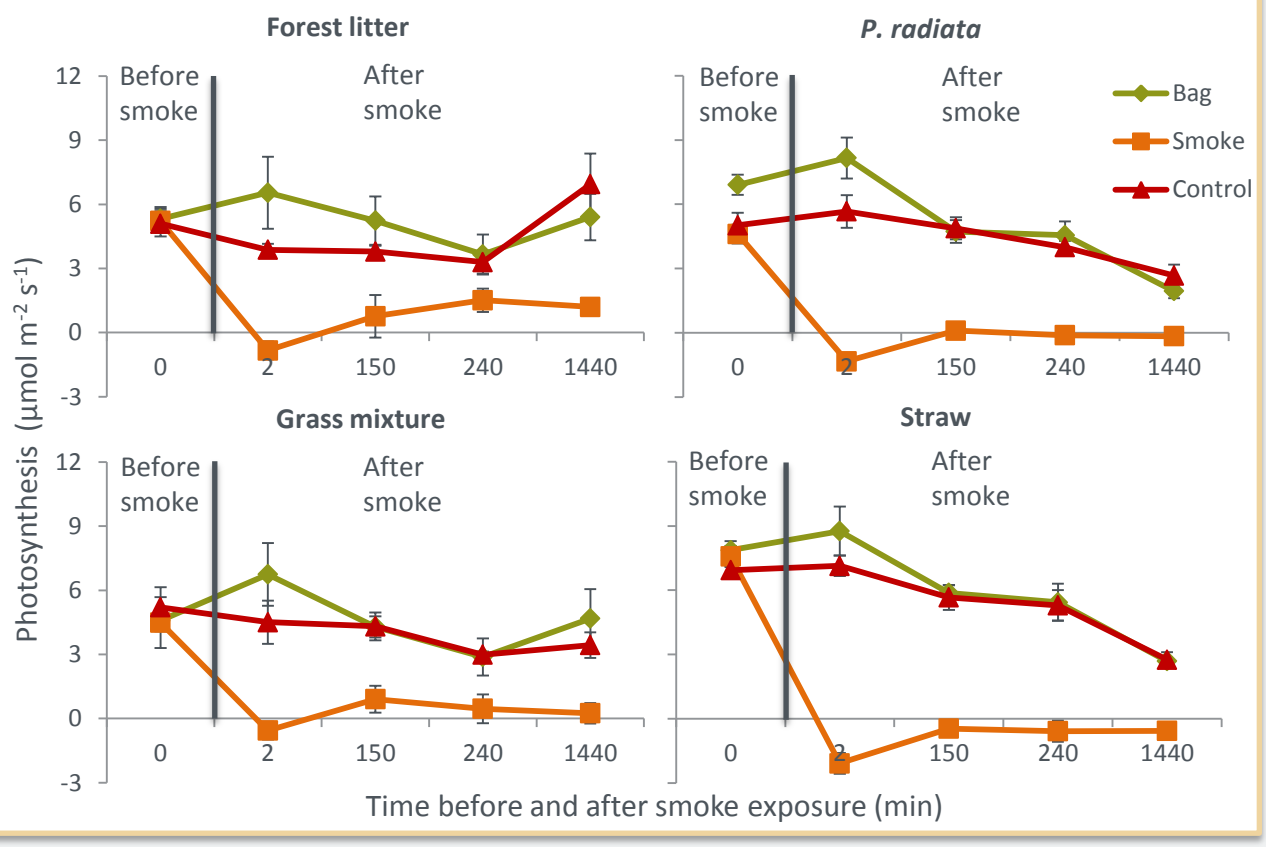
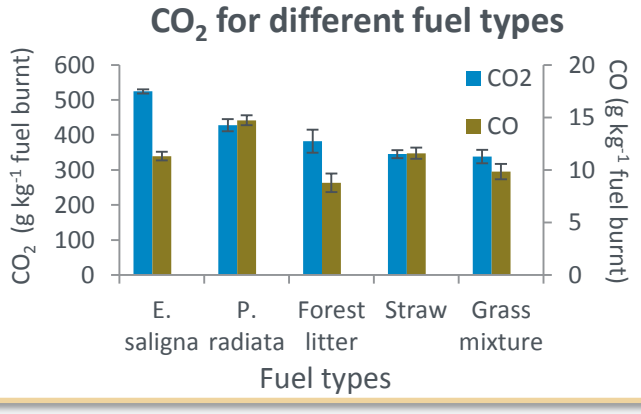


Figure 2: Emission factors for CO and CO_2 for different fuel types



- Smoke caused a significant reduction in photosynthesis for at least 24 hours in all species treated (ANOVA, $P < 0.05$, Fig. 1 & 2).
- Plants exposed to smoke from *P. radiata*, grass and straw showed little or no recovery in photosynthesis after 24 hours, but those exposed to smoke from forest litter showed recovery (Fig. 1).
- The emission factor for CO_2 was highest for *E. saligna* and the lowest for grass mixture (Fig. 2).
- The emission factor for CO was highest for *P. radiata* and lowest for forest litter (Fig. 2).

Outcome: This project elucidates how plant physiology is effected by different types of smoke that can occur during prescribed burning and bushfires. This knowledge will contribute to infrastructure management plans and preventative measures for smoke exposure on agricultural crops, making it relevant for a range of stakeholders.

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