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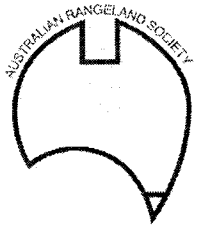

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SOIL RESOURCE TRANSFER AFTER DISTURBANCE IN SEMI-ARID WESTERN AUSTRALIA

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ABSTRACT

Nutrient-rich patches occur around grass tussocks, logs and trees in semi-arid landscapes. Landscape patterns and processes associated with such nutrient patches can influence lateral water movement but it is not known to what extent lateral flow in turn affects soil nutrient transfers. Large-scale disturbances, such as fire, occur frequently in the arid zone of Australia and can alter the landscape by removing obstacles that might otherwise promote accretion of organic matter owing to lateral movement of water. We examined lateral movement of nutrients through the soil in a recently burnt and unburned spinifex (*Triodia* sp.) community in the semi-arid Pilbara region of northern Western Australia. Nutrient treatments were applied to individual $1m^2$ sub-plots in burnt and unburned areas in order to examine nutrient movement over time. At 3 and 8 months after application, there was no significant transfer of P outside of the application plots and no significant difference between burnt and unburned sites. However, after 11 months, P transfers to at least 10 cm outside of the plots were discernible. Lateral movement of P was significant only in burnt areas, although trends were similar in both burnt and unburned plots, i.e. CV was greater in unburned plots. Nutrient transfer is an extremely slow process and is likely to be highly dependent on frequency and intensity of rainfall, as well as soil characteristics.

INTRODUCTION

Soil resources are heterogenously distributed throughout arid and semi-arid landscapes (Noy-Meir, 1985). In these regions, nutrient-rich patches occur around grass tussocks, logs and trees. Nutrient patches are thought to develop through accretion of organic matter owing to lateral movement of water (Tongway and Ludwig, 1990). Large-scale disturbances, such as fire, occur frequently in the arid zone of Australia and can alter the landscape by removing obstacles (e.g. grass tussocks) that might accentuate these nutrient-rich patches. Little is known about the effects of fire on nutrient movement in semi-arid landscapes. Tongway and Ludwig (1994) suggested that a decrease in plant density and cover might result in decreased retention of nutrients within a system. The aim of this experiment was to quantify lateral transfer of nutrients after rain in burnt and unburned parts of the landscape.

METHODS

Study sites were established on Hamersley Station (22°17'S; 117°40'E) in November 2000. The climate is sub-tropical and summer rains predominate owing to seasonal cyclonic activity. However, rainfall is highly variable within and among years. Experimental plots were established in recently burnt and unburned spinifex (*Triodia pungens*). Phosphorus (applied as superphosphate granules) and nitrogen (as 99.9% enriched $^{15}NH_4$) were applied to individual $1m^2$ sub-plots in experimental plots in order to examine the direction of nutrient movement over time. All treatments were compared to reference plots (no nutrients applied). Soil samples were taken along a down-slope axis from within the plot and at 10, 25 and 100cm from the edge of the application plot, following the wet season in March 2001. Plots were sampled again in July and October 2001, and March 2002. Inorganic P (P*i*) was estimated by extraction with anion exchange membranes (AEM) and NaOH (Bentley *et al.*, 1999). Soil was analysed for N content (%) and ^{15}N natural abundance (‰) using an Automated Nitrogen Carbon Analyser-Mass

Spectrometer consisting of a Roboprep connected with a Tracermass isotope ratio spectrometer (Europa Scientific Ltd., Crewe, UK).

RESULTS AND DISCUSSION

The results presented here are preliminary results. Details of nutrients other than P will be presented at The Australian Rangelands Society 12th Biennial Conference.

Anion exchange membranes are considered to extract the most labile or mobile inorganic P (Saggar *et al.*, 1990; Bentley *et al.*, 1999). NaOH-extractable P is considered to include both readily mobile and less soluble forms of P. Where P was measured as either AEM-Pi or as NaOH-Pi, at 3 and 8 months after application, there was no significant transfer of P outside of the application plots and no significant difference between burnt and unburned sites (Figures 1 and 2). After 11 months, P transfers to at least 10 cm outside of the plots were discernible by AEM extraction. However, lateral movement of P was significant only in burnt areas, although trends were similar in both burnt and unburned plots, i.e. CV was greater in unburned plots

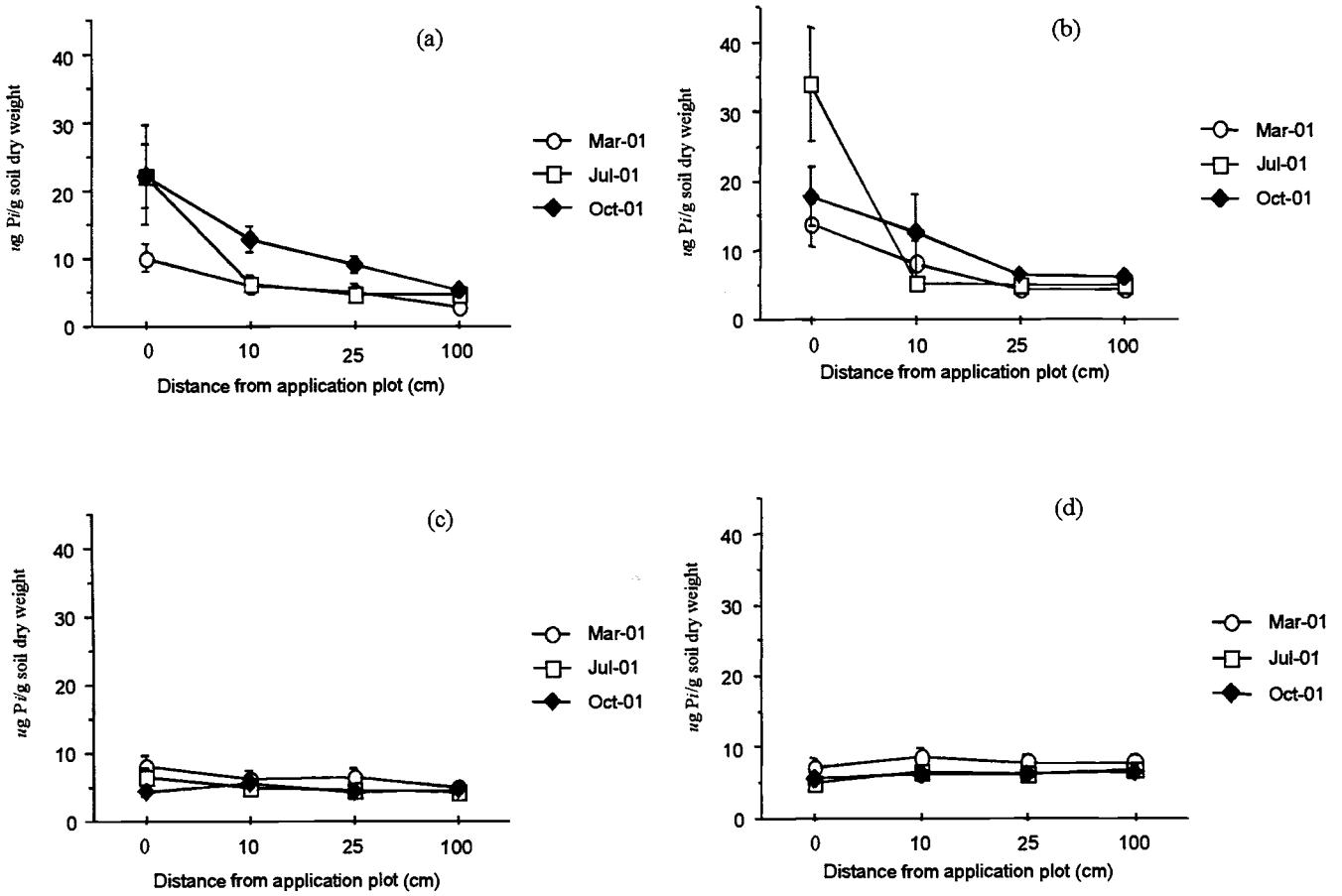

Figure 1: AEM-P*i* for three sampling dates, showing (a) burnt, P added; (b) unburned, P added: (c) burnt, control and (d) unburned, control (n = 9 ±se).

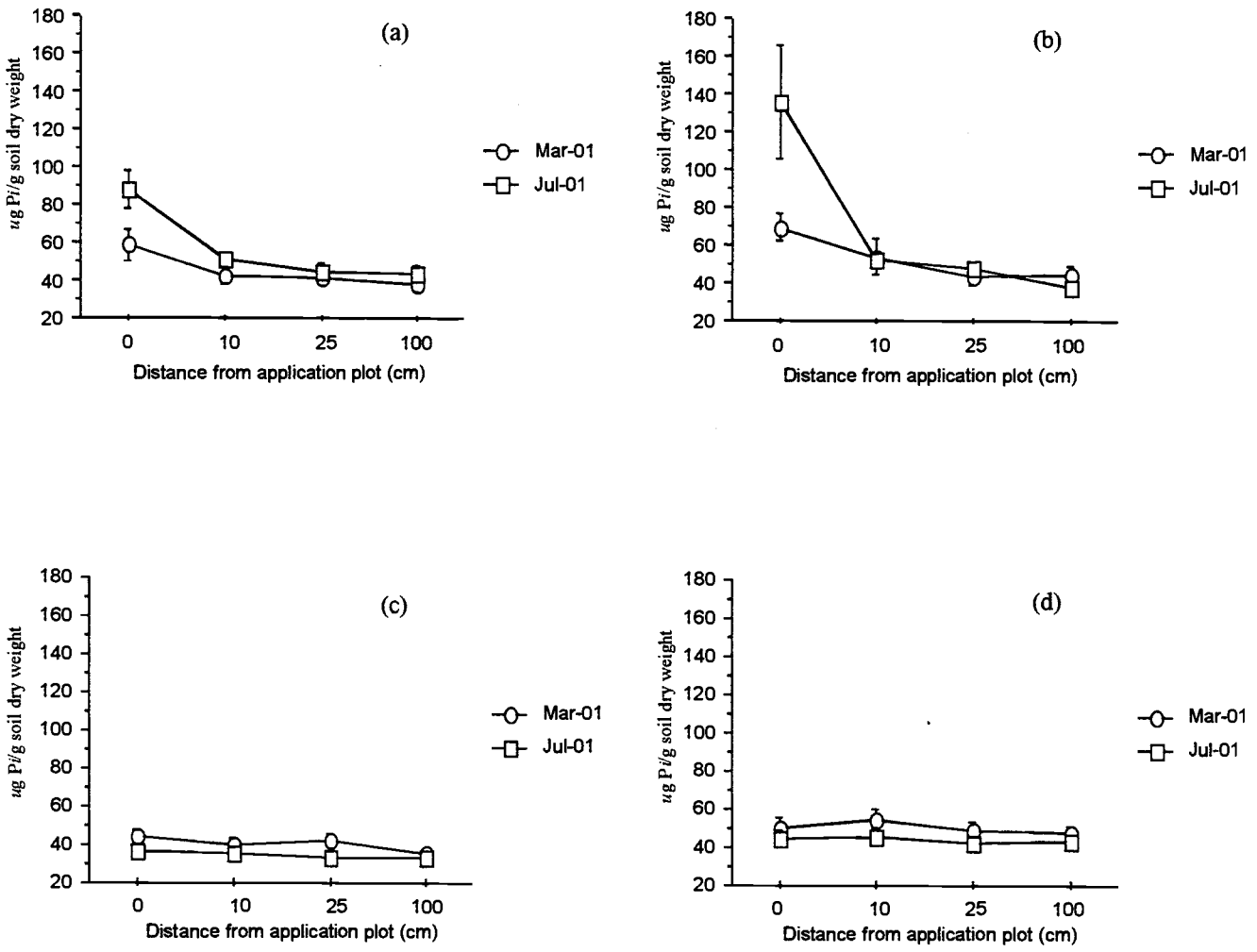

Figure 2: NaOH-P*i* for two sampling dates, showing (a) burnt, P added; (b) unburned, P added: (c) burnt, control and (d) unburned, control ($n = 9 \pm$se).

The greater variation in unburned plots is partly attributable to sampling, where samples were taken from both under tussocks, and in open spaces between tussocks, while burned plots were more uniform i.e. there were no tussocks. Phosphorus may vary with small-scale spatial position in arid/semi-arid landscapes, and concentrations may be higher in open areas (Rice *et al.*, 1994), or under vegetation (Schlesinger *et al.* 1996), depending on site. While there was summer rainfall (Nov-March) immediately after P application to the plots there were no significant changes in P concentration and movement until 8 months after application. It is likely that a large rainfall event after March 2001 mobilised P; however, rainfall data is yet to be fully analysed. Nutrient transfer is a slow process in the Pilbara and is likely to be highly dependent on frequency and intensity of rainfall, as well as soil characteristics.

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