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IMPACT OF THE AUSTRALIAN RICE FARMING SYSTEMS ON SOILS

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INTRODUCTION

Maintenance of soil fertility is a must for sustaining high paddy yields (8-12 t/ha) of the Australian rice farming systems. Soil fertility declines with intensive farming (Fig. 1) and it can not last long unless managed properly. Most rice research done in the past three decades mostly aimed at boosting rice productivity by using fertiliser N or leguminous pastures for building N fertility of rice soils. However, sustained harvest of maximum paddy yields in the future depends upon several other soil nutrients and properties that affect both status and availability of important essential plant nutrients. Research related to long term influence of rice or rice based farming systems on the changes in important nutrients other than N is limited. Such information is imperative to assess sustainable productivity of the rice based Australian rice farming systems. Hence, this research project with the following objectives.

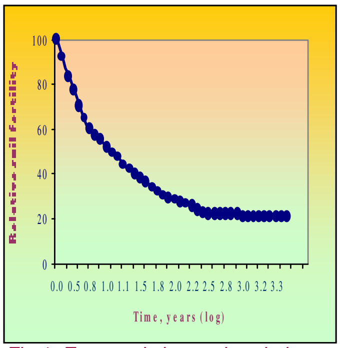

Fig 1. Expected change in relative soil fertility with intensive agricultural use.

OBJECTIVES

1. Evaluate the long term impact of the common rice farming systems on the changes in important properties of the prevalent soils; and
2. Establish sites typical of the Australian rice farming systems for future monitoring and quantitative assessment of changes in the soil properties pertinent to sustainable rice productivity.

METHODOLOGY

Soil samples were collected in 1998/99 and 1999/00 from rice paddocks within the CIA, MIA, Murray Irrigation Districts (MID) and a long term research trial at Deniliquin. In all, 672 surface (0-10 cm) and sub-surface (10-30 cm) soil samples (each being a composite of 20 sub-samples or locations) were collected from paddocks with different intensity of rice cultivation, soil types, cut and fill versus uncut, and recent cropping history. Soil samples are analysed for acidity (pH), salinity (EC), sodicity (ESP), total soil organic carbon, total soil N, total soil S, total soil P exchangeable cations (Ca^{++}, Mg^{++}, Na^{+} & K^{+}), and available (DTPA-extractable) Fe, Mn, Zn and Cu. This will help identify changes in soil nutrients pertinent to sustain fertility and productivity of rice soils. Some of the analytical results on 294 samples collected in 1998/99 are presented in this paper. After completion of analysis for the remaining soil samples, trends and variations due to different soils, cropping systems, cut and fill areas etc. will be reported.

RESULTS AND DISCUSSION

Total C in surface (0-10 cm) soil of selected rice paddocks ranged between 7.4 g/Kg on recently cut area and 42.2 g/Kg in the native woodland (Fig. 2). Mean and median were 17.2 and 17.3 g/Kg total C respectively. Considering documented literature, most paddocks are moderate in soil C or organic matter. Total soil C showed highly significant relationship with the soil N.

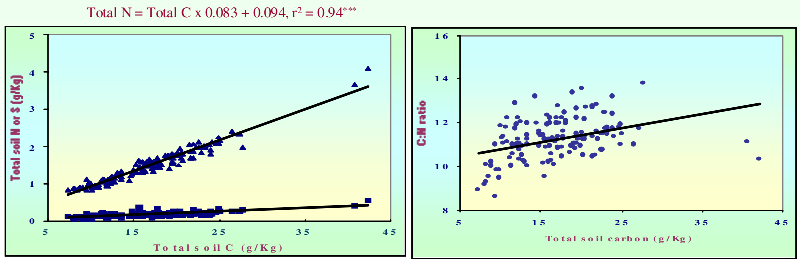

Fig 2. Total soil carbon and its relationships to total soil N (▲), S (■), and C:N ratio (●) sites.

However, there was a relatively poor relationship between soil C and C:N ratio of rice paddock surface (0-10 cm) soils (Fig. 2). Unlike N, S content of soils did not show high degree relationship with the soil C. Thus, both organic and inorganic constituents of soils may be important for availability and supply of S in rice paddocks. The interactions among important soil properties need to be investigated for quantitative determination of changes in the soil organic matter levels of the rice paddocks. Considering current usage of nitrogenous fertilisers and 50-55% recovery of N fertilisers, a further decline in the soil organic matter can not be ruled out.

Soil Acidity: Another important aspect of this project is to assess impact of rice farming systems on the soil degradation processes, if any. The soil pH is one of the most widely used general parameter that measures intensity factor of the acidity. Figure 3 shows moderate to high acidity in the surface (0-10 cm) layer of 147 rice paddocks whereas sub-soil (10-30 cm) was comparatively better off.

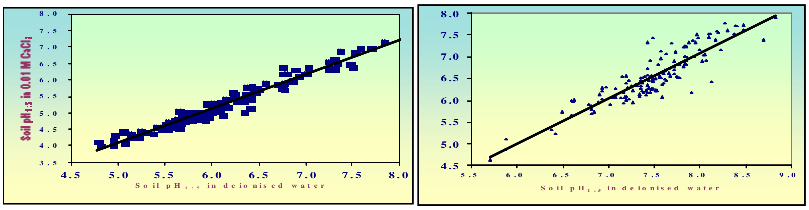

Figure 3. Relationship between pH in deionised water and 0.01 M $CaCl_2$ solution for surface (0-10 cm ■) and sub-surface (10-30 cm ▲) soils.

Measurements of pH in deionised water and 0.01 M $CaCl_2$ solution showed highly significant relationship (Fig. 3). Variation in pH shown in Fig. 3 indicates that productivity of crops especially legume grains or pastures when grown in rotation with rice may loose some productivity and N fixation. However, influence of acidity on rice may be the least. In the presence of sufficient soil organic matter, waterlogged conditions raise the soil pH. These conditions also restrict nitrification that acidify soils. Thus, rice has a role in ameliorating soil acidity to some extent.

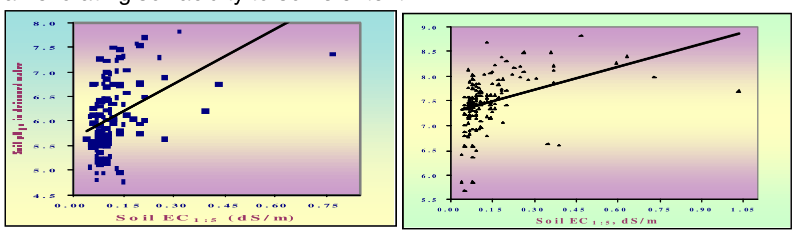

Fig 4. Relationship of soil pH and EC of surface (0-10 cm ■) and sub-surface (10-30 cm ▲) soil in rice paddocks.

Soil Salinity: Soil salinity as measured by EC indicated non-saline status of almost all sites. Surface (0-10 cm) soil $EC_{1:5}$ was mostly less than 0.2 dS/m (Fig. 4) except one sample with marginal status. Sub-soil (10-30 cm) $EC_{1:5}$ was also low except few rice paddocks or freshly cut areas. Waterlogging in rice is known to ameliorate soil salinity by leaching. Relation between EC and pH was not significant notwithstanding slight increase in the latter with increasing soil EC.

FUTURE WORK

After analysis of all the soil samples, impact of rice on changes in selected soil properties important for sustainable rice productivity will be reported.

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