# Yield and Mineral Concentration Changes in Maize and Italian Ryegrass Cropping Systems

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**Introduction** Mineral balance between plants and soil to which fertilizer has been applied is important in sustainable agriculture. Cropping systems are chosen based on considerations of crop yield, soil physical and chemical properties and climatic conditions. Thus, the sustainability of a forage cropping system should only be assessed after continuous cultivation has been practiced for several years. Forage crop production is employed in the rice paddies of Japan during summer. Thus, the objective of this study was to evaluate the yield and mineral concentration of forage crops cultivated in hard-textured soils for 4 years.

**Materials and methods** A typical cropping system for maize (sown from early May to mid-July) and Italian ryegrass (sown from October to November) was applied to the clay soils of the experimental field at the University of Miyazaki from 2001 to 2004. Cattle manure at 30 ton/ha, fused magnesium phosphate at 800 kg/ha, magnesium-calcium carbonate at 1 ton/ha, 100 kg/ha of N, 200 kg/ha of $P_2O_5$ and 200 kg/ha of $K_2O$ were applied as a basal fertiliser. From the initial soil analyses (April 2001), the pH was 5.9 and available phosphoric acid and total nitrogen content were 88 mg/kg and 1.8 g/kg, respectively.

**Results** Dry matter yield (DMY) for different parts of maize plants is shown in Figure 1. Total DMY for maize was significantly affected by the year due to the occurrence of typhoons and rainfall distribution (Figure 1). Total nitrogen (T-N) and total phosphoric acid (T-P) concentrations of maize were negatively correlated with DMY (r = - 0.966 for T-P), except for the lowest DMY and T-N concentration in 2004. Concentrations of T-N and T-P ranged between 0.25-0.42% and 0.19-0.29%, respectively. Total DMY of Italian ryegrass at the time of every harvest is shown in Figure 2. It was higher in 2001-02 and 2003-04 than in 2002-03. Total nitrogen (T-N) and total phosphoric acid (T-P) concentrations of Italian ryegrass were negatively correlated with DMY (r = - 0.785, and - 0.980 for T-N and T-P, respectively). Concentrations of T-N and T-P ranged between 0.55-0.14% and 0.23-0.41%, respectively.

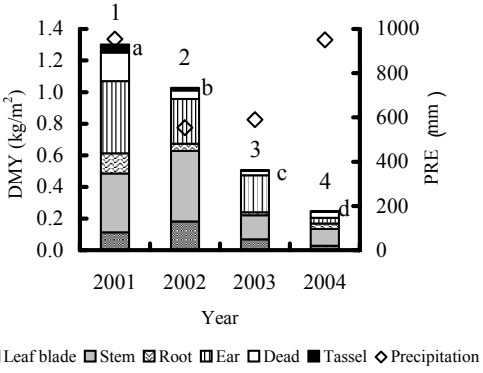


**Figure 1** Changes in dry matter yield (DMY) of each part of the maize plant and precipitation (PRE) from 2001 to 2004. Figures above the column indicate typhoon frequency. The values followed by different letters in whole plant were significantly different between years at $P<0.05$

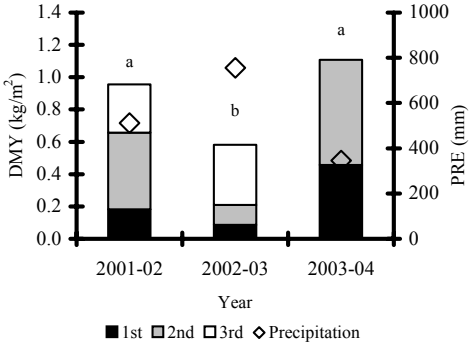


**Figure 2** Changes in dry matter yield (DMY) for each harvest of Italian ryegrass and precipitation (PRE) from 2001 to 2004. The values followed by different letters in the total DMY were significantly different between years at $P<0.05$

**Conclusions** DMY in maize was highly variable between years due to climatic conditions. The lower T-N concentration of maize is attributed to wet soils during the wet summer season. Annual total yields in both maize and Italian ryegrass were relatively stable and ranged between 1.62 to 2.26 kg/m$^2$.