ROOT SECRETION OF ORGANIC ACIDS AND ITS ASSOCIATION WITH ALUMINUM TOLERANCE IN MAIZE. Geraldo Magela de Almeida Cançado[(1)]; Hélio Teixeira Prates[(1)] & Gilson Vilaça Excel Pitta[(1)]; Vera Maria Carvalho Alves[(1)]; Robert Eugene Schaffert[(1)]; Maurício Antônio Lopes[(1)]. [(1)] – Embrapa Milho e Sorgo.

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Recent studies have suggested that the exclusion of Aluminum (Al) from root apices is the most likely mechanism employed by certain species to cope with the toxicity caused by this element. Mechanisms potentially involved in such exclusion include Al immobilization by cell wall, selected permeability of cell membrane, active eflux of Al, and secretion of chelating compounds, which would promote the neutralization of Al ions in the rizosphere. Organic acids such as citrates, malates, oxalates, succinates, tartarates, and *trans*-aconitate are commonly present in root exudates of a great number of plant species (Taylor, 1988; Kochian, 1995). It is postulated that there is a positive correlation between the secretion of these acids and the tolerance to Al toxicity. To investigate this hypothesis, the root exudates of two maize cultivars, CMS 36 (Al-tolerant) and BR 106 (Al-sensitive), were analyzed. Seeds were germinated in distilled water-soaked paper; after six days, eight uniform seedlings were selected, transferred to 250 mL-flasks containing a modified Steinberg's nutrient solution, pH 5.5 (Foy et al. 1967), and cultivated in a growing chamber. After ten days post-germination, the plantlets were subjected to two levels of Al (0 e 6 mg/L in the same nutrient solution, pH 4.0) for 24 hours. Aliquots of 20 mL of the nutrient solution were collected after 0.5, 6.0 and 24 h, liofilized, and resuspended in 1 mL of distilled-deionized water. The analysis of organic acids contents and composition was performed by high performance liquid chromatography (HPLC) in a reverse-phase column. We observed a very intense intervein leaf-chlorosis between the 6^{th} and 10^{th} day post-germination, suggesting a likely deficiency in iron and other nutrients, due to their rapid depletion in the nutrient solution. The resulting chromatograms demonstrated a clear variation in the patterns of exudation between genotypes, although we recognize that a possible interaction with the nutritional stress mentioned above could have affected the final outcome of the experiment. The Al-tolerant cultivar (CMS 36) showed a significantly higher concentration of malic acid, after 6 h of treatment, although no difference was observed in terms of presence/absence of Al (Figure 1). Similar trends were also observed for the citric acid, with significant differences only between cultivars (Figure 2). These results suggest the existence of Al-independent, constitutive genetic differences between the cultivars, regarding these acids. On the other hand, the cultivar BR 106 displayed a higher concentration of succinic acid in the presence of Al (Figura 3), whereas for the cultivar CMS 36, this trend was not observed. For the 0.5 and 24 h treatments, no significant difference was observed between genotypes and Al doses. However, it is worth mentioning that higher values of pH (around 7.0) for the nutrient solution were observed in all treatments, which could have conceivably inhibited the toxic effect of Al ions. Further work controlling the unexpected difficulties faced in these experiments are currently underway, in order to better understand the possible relationship between organic acids exudation and tolerance to Al ions of contrasting maize genotypes.

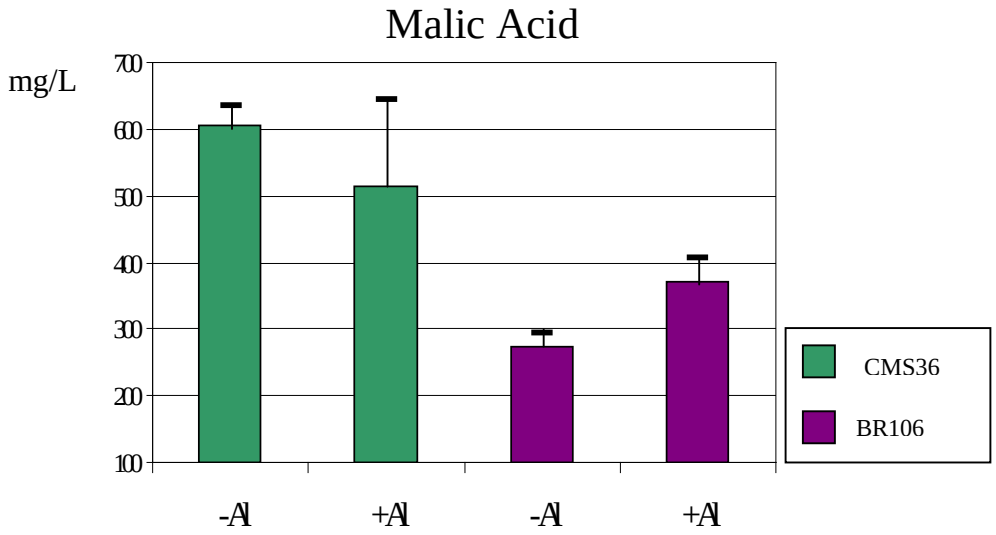

Figure 1. Concentration of malic acid (mg/L) for tolerant (CMS36) and sensitive (BR106) maize cultivars, after 6 h in the presence / absence of 6 mg/L of Al in the nutrient solution. Differences between genotypes by ANOVA was significant at $P < 0.05$; CV = 15.82 %

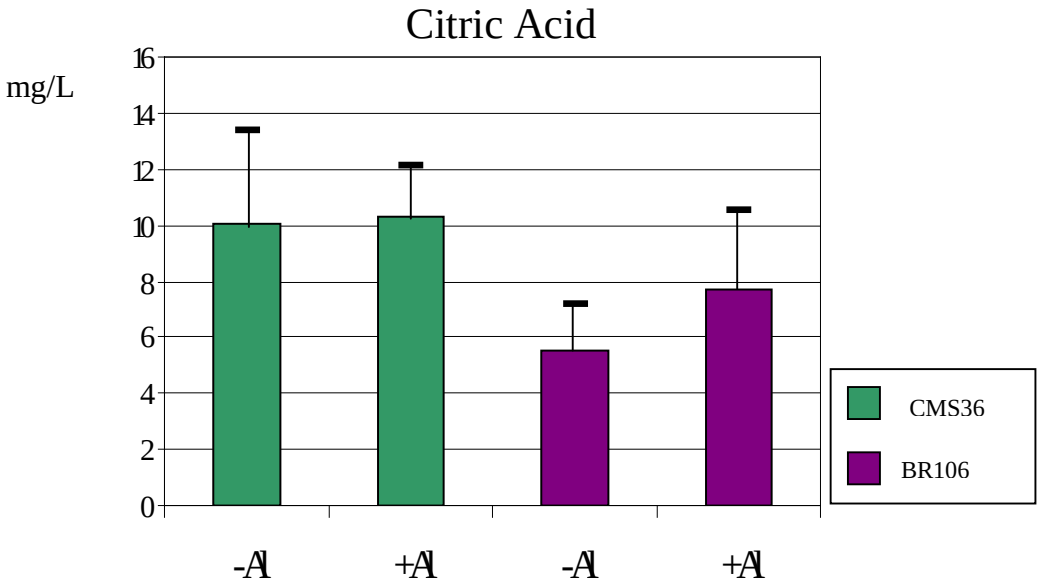

Figure 2. Concentration of citric acid (mg/L) for tolerant (CMS36) and sensitive (BR106) maize cultivars, after 6 h in the presence / absence of 6 mg/L of Al in the nutrient solution. Differences between genotypes by ANOVA was significant at $P < 0.05$; CV = 30.1 %

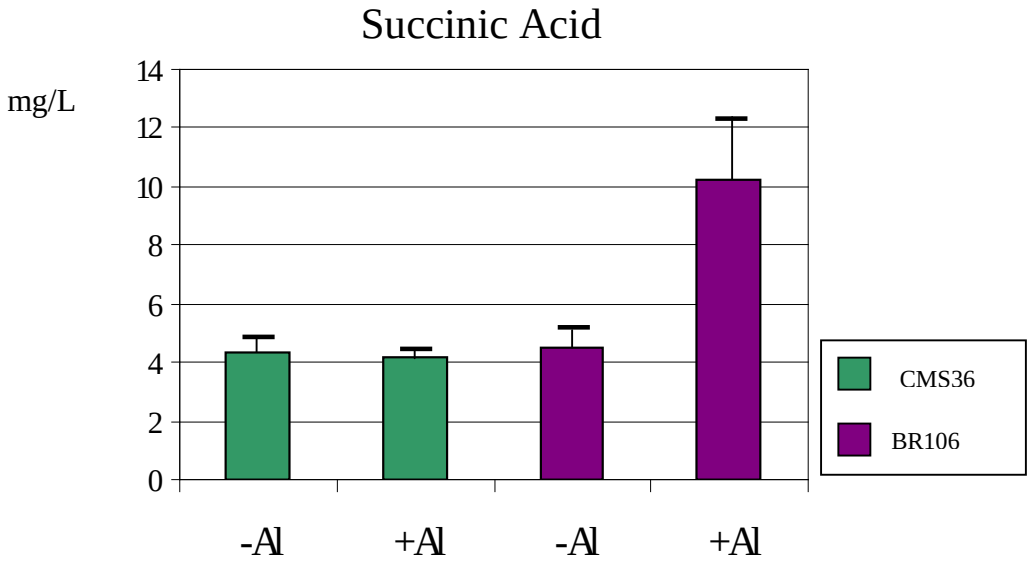

Figure 3. Concentration of succinic acid (mg/L) for tolerant (CMS36) and sensitive (BR106) maize cultivars, after 6 h in the presence / absence of 6 mg/L of Al in the nutrient solution. Differences between genotypes and Al levels by ANOVA was significant at $P < 0.05$; CV = 18,75%

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