Nitrogen use efficiency in maize crops in early and late sowings

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Introduction

In the temperate areas of Argentina, maize crops were traditionally sown at early spring (September-October). After the appearance of transgenic maize hybrids resistant to Lepidopterae, the late sowed maize crops (December to mid-January) have spread. In late sowing date, vegetative period is exposed to high temperatures, which not only affect crop growth but also soil nutrient dynamics. Currently, all maize genotypes are handled in the same way to the application of N under these conditions.

Objective

The aim of this work was to evaluate N use efficiency (NUE; in kg grain per unit of available N) and its components: N utilization efficiency (NutE; in kg grain per unit N uptake) and N uptake efficiency (NupE; in kg N uptake per unit available N) between different maize hybrids in contrasting environments (locations x sowing dates).

Materials and Methods

Field experiments were carried out during the 2014-2015 growing season, in two sites, located at Experimental Station of National Agricultural Technology Institute in Paraná (EEA INTA Paraná), Argentina (Lat. 31.8°S) and Technology Development (TD) Monsanto Research Station in Pergamino, Argentina (Lat. 33.9°S). At each location, experiments included a combination of two sowing dates (early and late sowing date), three N rates (0, 90 and 270 kg N ha^{-1}) and four hybrids (DK66-10VT3PRO, DK70-10VT3PRO, DK72-10VT3PRO, DK73-10VT3PRO). Treatments were arranged in a randomized complete block design with three replications.

Results and Discussion

✓ Nitrogen Use Efficiency differed among hybrids ($P<0.05$) and was linearly reduced by N rate ($P<0.001$) (Fig. 1a y 1b), in both locations.

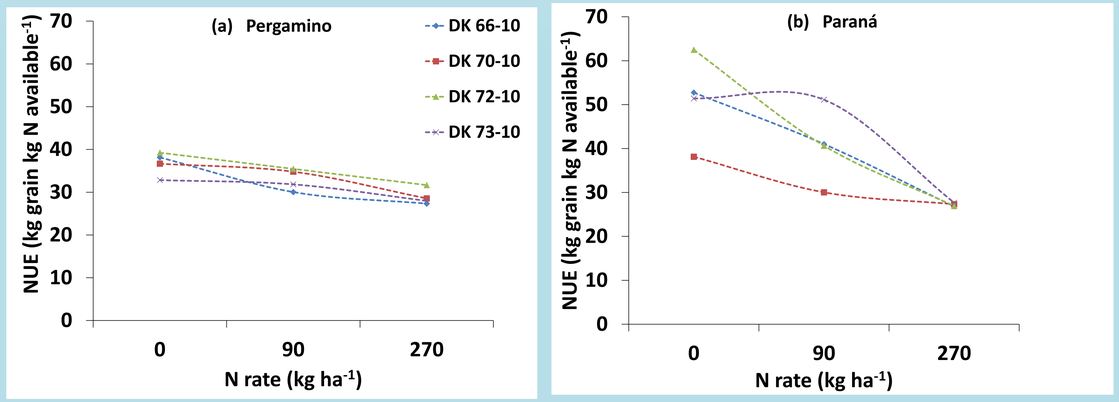


Figure 1. Nitrogen Use Efficiency as a function of N rate and hybrids in Pergamino (a) and Paraná (b).

✓ Different slopes among SD and locations were detected (Fig. 2). Hybrid DK73-10VT3PRO had the lowest NUE reduction by N rate.

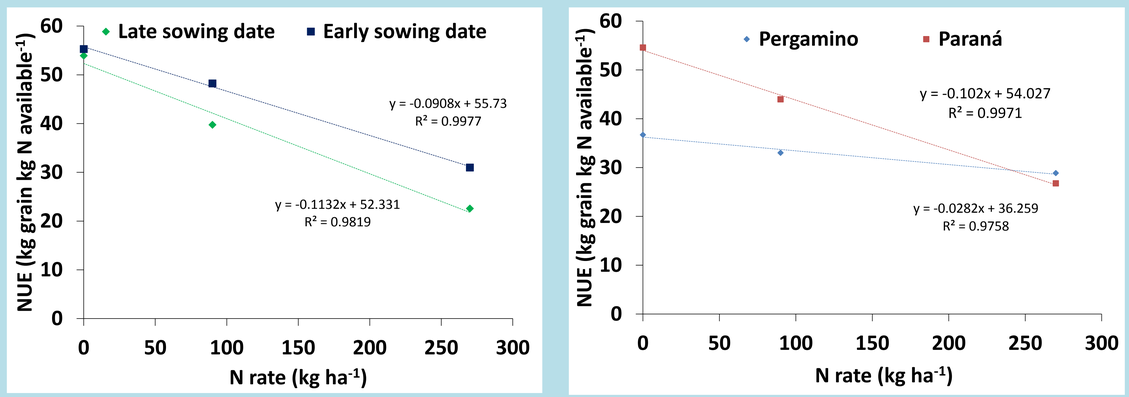


Figure 2. Nitrogen Use Efficiency as a function of N rate, sowing date (early and late) and site (Pergamino and Paraná)

✓ More than 67.4% of NUE variations were accounted ($P<0.0001$) by NupE variations (Fig. 3).

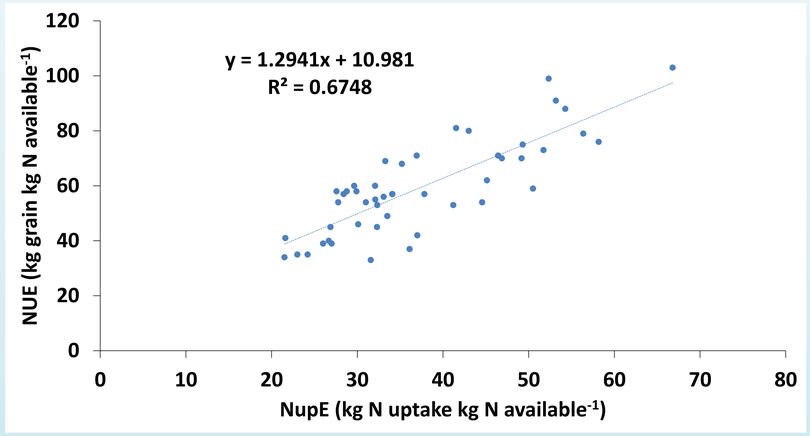
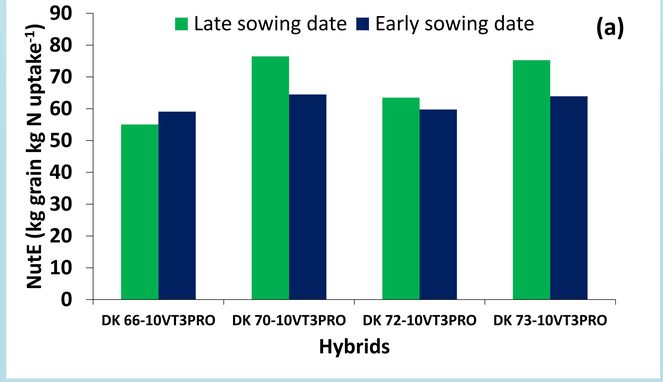


Figure 3. Relationship between NUE and Nitrogen Uptake Efficiency.

✓ NupE differed among hybrids ($P<0.001$), it was reduced as N rate was increased and was higher in early than in late SD only in Paraná.

✓ Nitrogen utilization Efficiency of DK70-10VT3PRO and DK73-10VT3PRO was consistently higher ($P<0.002$) across locations and SD and was decreased as NupE was increased only in Paraná (Fig. 4a y 4b).



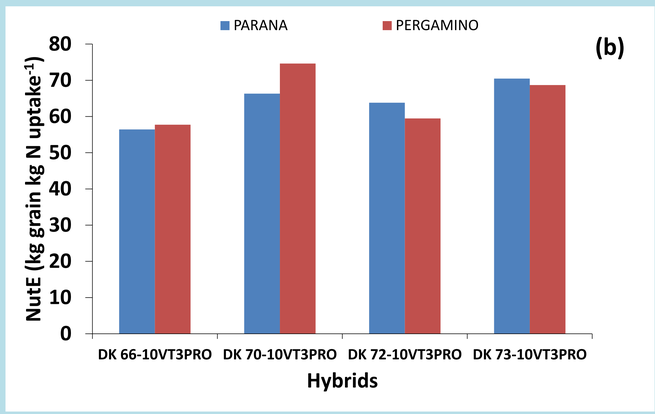


Figure 4. Nitrogen Utilization Efficiency for early and late sowing date (a) and sites (b)

Conclusions

✓ Nitrogen use efficiency differed among hybrids, and showed lower decrease as function of N rate in DK73-10VT3PRO. Nitrogen use efficiency was related to Nitrogen uptake, and was lower in late sowing date.

✓ It is essential to know the hybrid response to N and the environment of N for proper management.