

Increasing nitrogen use efficiency by using controlled release fertilizers fitted to the crop needs

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General view of the experiment

Introduction

Modern sustainable agriculture demands efficient fertilization practices in order to meet governmental standards, legislations and requirements of retail organizations. Losses of nitrogen by leaching, volatilization or denitrification can dramatically reduce the efficiency of the applied nitrogen, which in today's farming is no longer acceptable. For this reason, it is urgent to find solutions which improve the Nitrogen Use Efficiency (NUE) while reducing nitrogen losses.

Controlled release (coated) fertilizers are relatively new in the agricultural market and offer a predictable and consistent release of nutrients in a specific period of time. Since the amount of nitrogen released daily is small and goes in line with plant uptake requirements, this sort of fertilizers could be an ideal tool to reduce nutrient losses and optimize the NUE (Diara et al., 2014; Terlingen et al., 2016).

Materials and Methods

Specific leaching studies have been executed in the period 2015-2016 in cooperation with the University of Pisa. In order to overcome the complications caused by the un-controlled rainfall typical on an open-field system, the experiments were conducted in a greenhouse of the University of Pisa. For this purpose, a lysimeter system was used, built using big containers (180 liters volume), filled with sandy soil. The main goal of these trials was to quantify the reduction of N leaching in a tomato crop (F 1 "Optima") when using N-coated fertilizer (Agrocote, made using the E-Max technology) as compared to traditional N fertilizers used for base fertilization. The experiment was designed in order to apply 10 g N, 1.2 g P and 12 g K for each tomato plant during the whole growing cycle, using different N sources as base fertilization:

- Control (grower's practice): 2.5 g N as ammonium sulphate
- E-Max 50%: 5.0 g N as Agrocote Max N
- E-Max 75%: 7.5 g N as Agrocote Max N

The remaining N was applied via fertigation. Besides N leaching, other parameters such as yield and N uptake were measured in this study. In order to calculate NUE indicators, a zero fertilizer treatment was included (data not shown). All the drainage leaked from the lysimeter was collected and analyzed for its N content. Data on fruit quality and quantity were also recorded.

References

Terlingen, J.G.A., Radersma, S., Out, G.J.J., Hernandez-Martinez, J., Raemakers-Franken, P.C. (2016) Current Developments in Controlled Release Fertilizers. *Proceedings / International Fertiliser Society*: 781 (ISSN 1466-1314).

Diara, C., Incrocci, L., Incrocci, G., Carmassi, G., Pardossi, A., Cozzi, P., Fibbi, F., Marzalletti, P. and Clemens, R. (2014). Reduction of Nutrient Run-off by the Use of Coated Slow-Release Fertilizers on Two Container-Grown Nursery Crops. *Acta Hort.* 1034, 85-91.

Results and Discussion

As seen on Table 1, the use of E-Max coated N significantly reduced the amount of N leached. This was found despite the fact that the E-Max treatments had a higher fraction of the total N added as base fertilizer. This reduction in leaching was even more evident when a higher percentage of the total N was applied as E-Max coated N (E-Max 75%). In respect to yield and N uptake by the fruits, the use of E-Max coated N had a clear positive effect. The highest yields and N uptake rates were obtained when a higher percentage of the total N was supplied as E-Max coated N.

There was a significant improvement in both NUE indicators considered for this study (Figure 1), where the efficiency rate was positively correlated with the amount of N supplied via E-Max coated N.

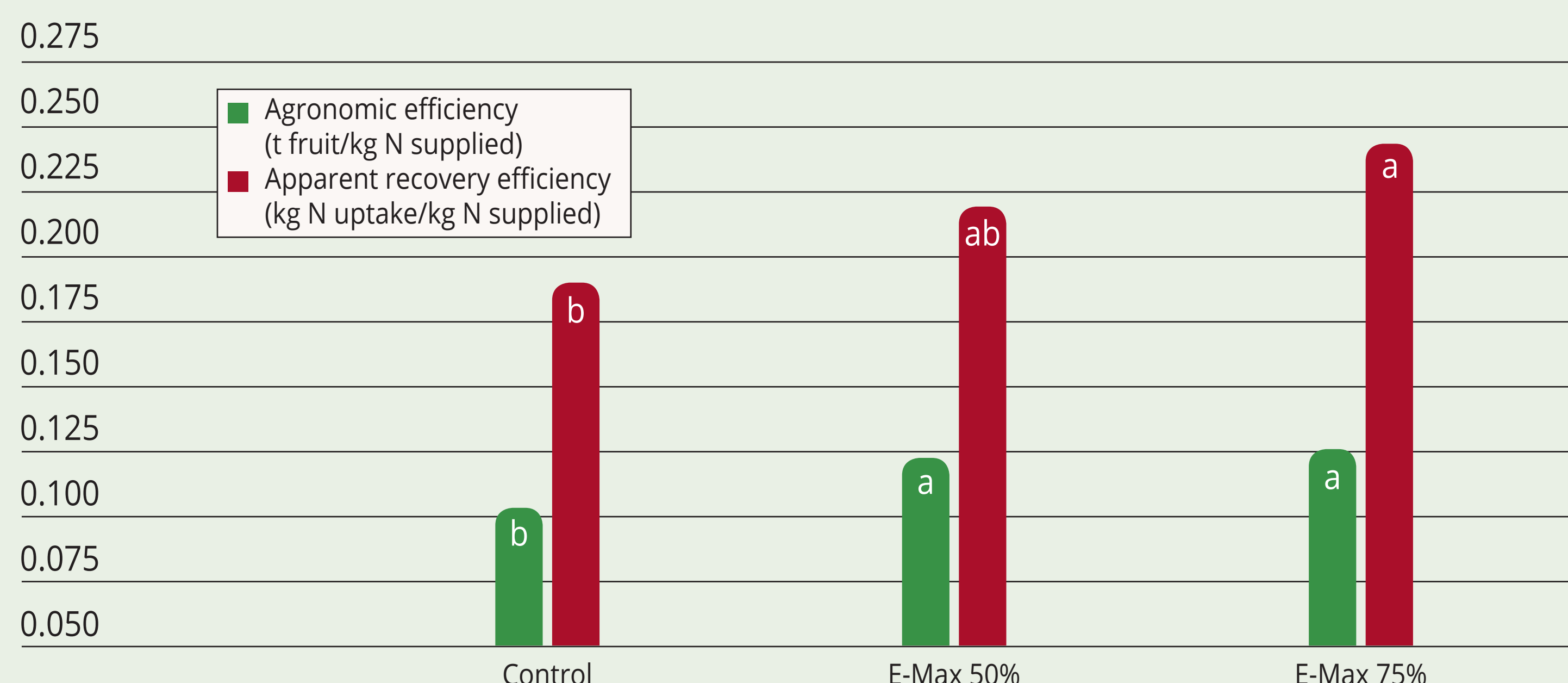
Table 1. Nitrogen source influence on different parameters.

Different letters identify significant differences ($P < 0.95$), according to Tukey test.

Parameter	Control	E-Max 50%	E-Max 75%
N leached (kg/ha)	46.0 a	28.4 b	20.0 c
Total yield (t/ha)	42.1 b	47.0 ab	49.5 a
Total N in the fruits (kg/ha)	67.3 b	75.5 ab	84.3 a

Figure 1. Nitrogen source influence on NUE parameters.

Different letters identify significant differences ($P < 0.95$), according to Tukey test.



Conclusions

- ① The use of coated nitrogen as base fertilizer had a clear effect in reducing nitrogen losses, increasing yields and improving the NUE.
- ② The effects were more pronounced when the relative amount of E-Max coated N increased, which proves that this technology is a promising tool to improve fertilization efficiency.

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