

Nitrogen use efficiency of maize and cotton in 1.32 Mha of commercial farms in Brazil

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Abstract

We used data from 2011 to 2019 of cotton and maize yields and N fertilization of 4,519 commercial fields covering 1.32 Mha in Brazil to calculate nitrogen use efficiency (NUE), N export with grains and lint+seeds, and N surplus. Despite the wide variations expected in such an extensive database, the average N sustainability indicators were satisfactory and within the desired range suggested by Oenema et al. (2015) of NUE (over 50% and below 90%), N surplus under 80 kg ha⁻¹, and N export over 80 kg ha⁻¹. These indicators are useful for farmers to adjust practices to reduce environmental impacts while preserving yields and profitability.

Keywords: NUE, cotton, maize, N export, N surplus

1. Introduction

Improving NUE has positive impacts on profits and the environment. Access to markets and favorable image are increasingly dependent on sustainable production, a concern of commercial agricultural companies.

2. Material and Methods

SLC Agrícola is a large Brazilian company that grows soybeans, maize, cotton, and other crops in more than 400,000 hectares every year. We used data of N fertilization and yields of 4,519 fields, grown with first (summer) and second crop (fall) maize and cotton, mostly on no-till, in 1.31 Mha. Different crop rotations were used, depending on the season, climate and region. Usually, 2nd season maize was grown after soybean. Most cultivation units are farms with over 200 ha, for which SLC has detailed records.

We estimated N export using grain and lint+seeds yields, multiplied by 13.9 and 13.1 kg N t⁻¹ grain for first and second season maize and 23.1 kg N t⁻¹ cotton. NUE is the ratio of exported over applied N. Other N indicators were estimated

using the conceptual framework suggested by Oenema et al. (2015).

3. Results and Discussion

The average N surplus (N applied minus N exported) varied from 14 to 65 kg ha⁻¹ for maize and 52 to 67 kg ha⁻¹ for cotton; the NUE went from 64 to 89% for maize and 60 to 66% for cotton (Table 1). These values are within the desired range of NUE, N export, and N surplus of Oenema et al. (2015) conceptual framework (Fig. 1). As expected for over 4 thousand field observations, there was a wide variation of results as yields and N exports are affected by climate and other factors.

References

Oenema O, Brentrup F, Lammel J, Bascou P, Billen G, Dobermann A et al. 2015. *EU Nitrogen Expert Panel - Nitrogen Use Efficiency (NUE) - an indicator for the utilization of nitrogen in agriculture and food systems*, Wageningen University - Alterra.

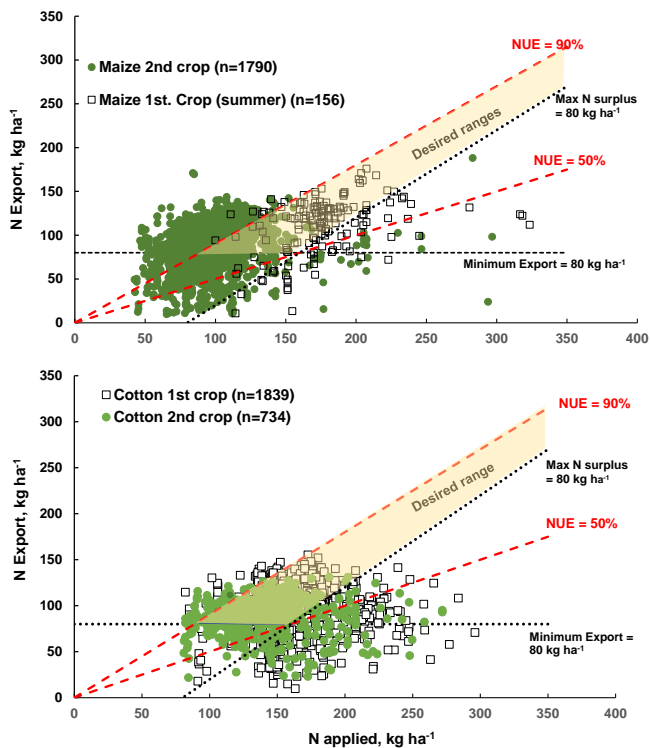


Fig. 1. Conceptual framework of NUE of maize and cotton in 4,519 commercial farms in Brazil from 2011 to 2019

Table 1. N export, NUE, and N surplus in commercial cotton and maize grown in 1.32 million hectares in Brazil. Mean ± std

Crop	N rate	Yield	kg ha ⁻¹		NUE
			N export	N surplus	
Maize (1 st season)	176 ± 35	7,980 ± 2,259	111 ± 31	65 ± 37	64 ± 18
Maize (2 nd season)	100 ± 24	6,556 ± 1,975	86 ± 26	14 ± 30	89 ± 30
Cotton (1 st season)	164 ± 24	4,144 ± 930	97 ± 22	67 ± 32	60 ± 16
Cotton (2 nd season)	143 ± 30	3,860 ± 829	91 ± 20	52 ± 35	66 ± 18

Maize 1st season: 156 farms, average area 322 ha; 2nd season: 1790 farms, average area 259 ha.

Cotton 1st season: 1839 farms, average area 330 ha; 2nd season: 734 farms, average area 281 ha.