Effects of sodium fertilization in sugar beet on sandy soils in The Netherlands

André van Valen

Institute of Sugar Beet Research (IRS), P.O. Box 20, 4670 AA Dinteloord, The Netherlands

Introduction

Sandy soils are poorly able to retain nutrients such as sodium. Because in the past sugar beets have been shown to have a sodium requirement, fertilization is recommended on these soils. The recommended dosage is 200 kg Na_2O per hectare, based on trials in the 1990s. Some regions used to have enough manure to meet these requirements. Reduced use of manure in the past decades has raised the question whether additional sodium fertilization is necessary in these regions.
Cultivation data also showed that sugar beets fertilized with sodium achieved higher sugar yields compared to those not fertilized with sodium.

Materials and methods

Eight field experiments were conducted from 2020 to 2022. These trials were located in the southeast of The Netherlands. All locations were sandy soils and had a low content of plant-available sodium. Four different sodium treatments were given on each trial (0, 100, 200 and 300 kg Na_2O/hectare), see **figure 1**. In addition, some trial fields had objects with different potassium rates.
Leaf dry matter (DM) was measured (**figure 3**), as well as nutriënt content in the leaves at canopy closure (June) and when maximum leaf mass was reached (August). In one trial, leaf mass was weighted. All trials were harvested for yield determination and internal quality analysis.

Figure 1. Sodium was applied some days or weeks before sowing by using a granular fertilizer and incorporated into the soil.

Conclusions

Sodium fertilization is recommended on sandy soils with a low sodium availability. 200 kg Na_2O/ha leads to the highest financial yield, due to higher root yield and sugar content. Increasing sodium gifts resulted in a lower DM-content. A lower DM-content can potentially offer benefits during periods of drought.

IRS *Institute of Sugar Beet Research*
Kreekweg 1,
NL-4671 VA Dinteloord
www.irs.nl
valen@irs.nl

Results

Increasing sodium gifts resulted in a higher sodium content in the leaves at both moments. Above-ground biomass increased as well. At the same time, the DM-content consistently decreased (**figure 2**). The content of other cations (potassium, magnesium, calcium) decreased as well.

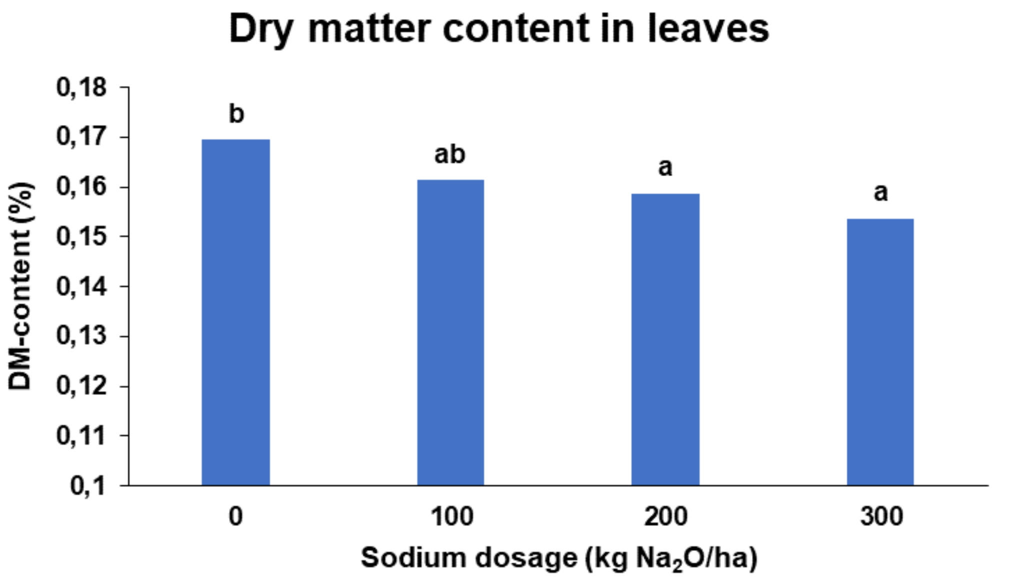

Figure 2. Dry matter content in the leaves decreased significantly with higher sodium dosages (P = 0.004; LSD 5% = 0.008).

Sodium fertilization increased root yield and sugar content, without negative effects on internal quality. Details are given in **table 1**. Because of these yield effects, sugar yield increased by an average of 1 ton per hectare. The financial yield reached the optimum at a sodium fertilization of 200 kg Na_2O/ha.

Table 1. Relative root yield and sugar content at various sodium dosages. Average from eight field trials in 2020 to 2022.

Sodium dosage (kg Na_2O/ha)	Relative root yield (ton/ha)		Relative sugar content (%)	
0	100.0	a	100.0	a
100	102.0	ab	101.1	b
200	103.9	b	102.2	c
300	104.3	b	103.0	c
Probability	0.009		<0.001	
LSD 5%	2.68		1.08	

In three trials, applying 200 kg Na_2O/ha without K_2O resulted in a greater yield response than 200 kg K_2O/ha without Na_2O. This was primarily visible in a higher sugar content. Fertilization of Na_2O without K_2O, resulted in higher Na-content in roots, compared to applying both elements. Despite the higher availability of cations, internal quality did not change significantly.

Figure 3. When sodium was applied, leaves contained much more sodium and less dry matter during summer. Total leaf mass also increased.