

The effects of organic and mineral amendments on the rehabilitation of saline soils and their impact on crop yields

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Absract

This study examines trials of various organic and mineral soil amendments, used alone or in combination, on a saline soil.

Salinisation is primarily due to the poor quality of the groundwater used for irrigation. There has been a significant increase in salinity, which rose from 35% in 1956 to nearly 80% in 2005.

This soil is characterised by high salinity according to the Durand classification, moderate levels of total limestone (20%) and clay (35–40%), poor structural stability, and low organic matter content (less than 2%) in plots F6, N8, N9 and N10. The various organic and mineral amendments aim to improve: physical properties: structure and permeability; chemical properties: reduction in salinity and sodicity; and crop yields.

A set of 60 soil samples was collected from top and subsoil (0–20 and 20–35 cm respectively), on which the following physicochemical analyzes were performed: Ca²⁺, Mg²⁺, K⁺, Na⁺, Cl⁻, SO₄²⁻, HCO₃⁻, NO₃⁻, pH, electrical conductivity (EC) and sodium adsorption ratio SAR.



Materials and study Methods

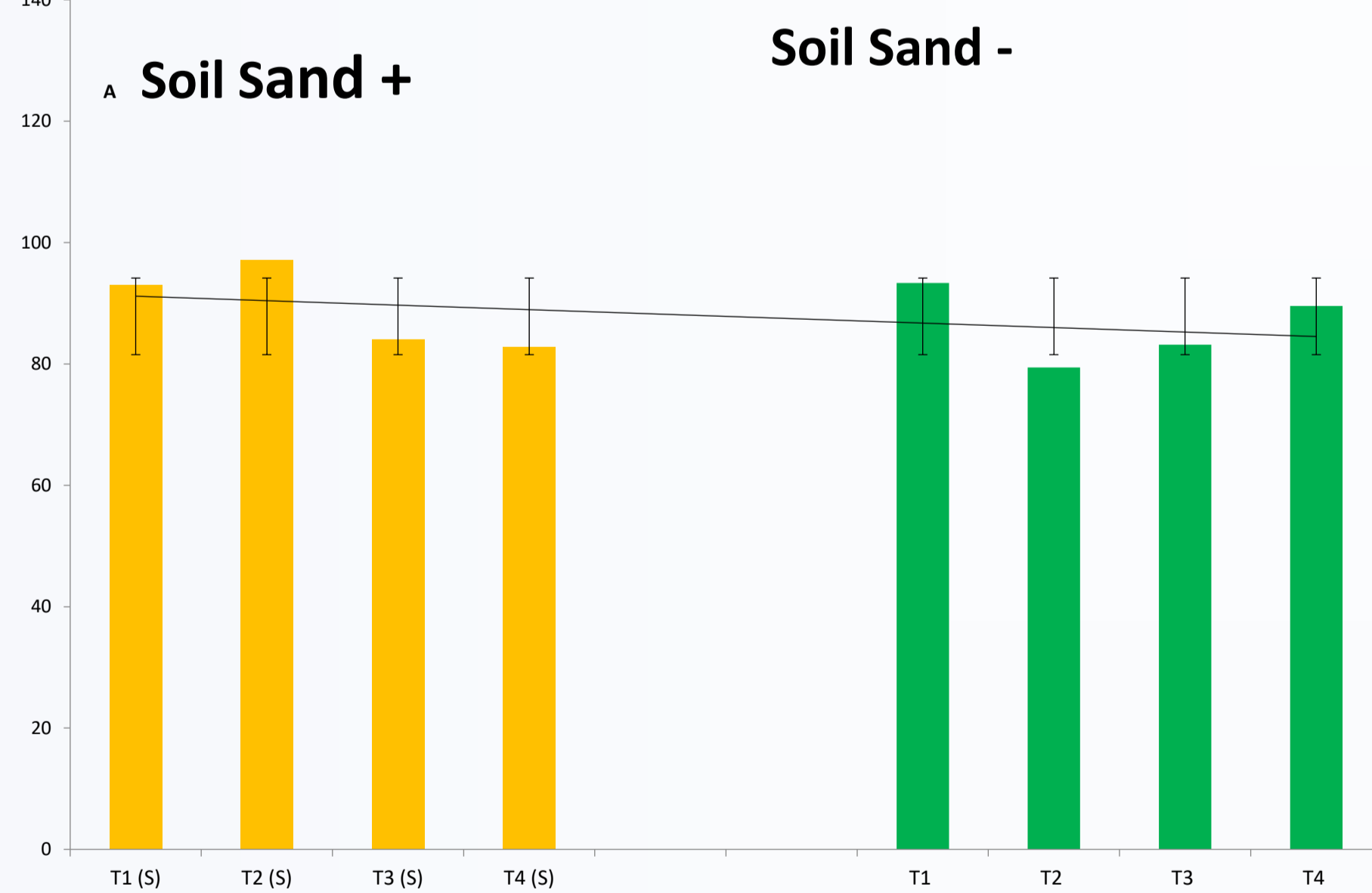
The experimental design is a completely randomised block design (3) replicates x (4) treatments. Plant material: barley in the first year (2018–2019) and soft wheat (ANFORETA) in the second year (2019–2020)

Results

-Assessment of irrigation water quality (Method USSL, 1954)

- **Salinity:** EC (dS/m) = 1.65 dS/m high risk of salinity
- **Sodicity:** SAR < 10 low risk of sodicity,
- **Residual Sodium Carbonate (RSC):** indicates the risk of alkalisation due to irrigation. This parameter predicts the tendency of CaCO₃ to precipitate in the presence of high bicarbonate levels:
 $RCS = [(CO_3^{2-} + HCO_3^-) - (Ca^{++} + Mg^{++})] < 1.25$
 Risk associated with residual sodium carbonate (which causes high pH levels) is virtually nil. This finding is confirmed by the presence of neutral salts (NaCl, Na₂SO₄) with a pH below 8.5

Comparison of wheat yields in the experimental plot with and without sand added 2019-2020



Comparison of yields at plot level (N8-N9-N10) treated with sand and untreated N567

Conclusion:
The results obtained are very interesting and were confirmed from the second year onwards for all four amendments used.

However, the combination of organic and mineral amendments in treatment T4: Sand + Manure + 1/2 (Gypsum + FeSO₄) stands out from the other treatments due to a very positive and significant impact on soil properties as well as on yields.

The following observations were made: Reduction in soil salinity: The control soils N8, N9 and N10, classified by Durand as very saline, showed a reduction in salinity of 62% for H1 and 54% for H2 in the second year (2020) following the amendments.

This reduction in salinity has a positive impact on the ionic balance in the soil solution, reducing the toxicity of sodium and chlorides, and also lowering the osmotic pressure of the soil solution on the plant.

The evolution of SAR parameter indicates that the risk of sodicity, as measured by exchangeable sodium, is well below 10, meaning the risks are low.

A significant decrease in pH has been recorded; average values remain below 7.4, which considerably improves the bioavailability of nutrients in the soil solution. Improved yields were achieved

Objectives of this study

- **Improvement in the physical and chemical fertility of the soil**
Reduction in soil salinity and sodicity: Restore ionic balance: Na⁺/K⁺; Cl⁻/SO₄⁻; reduce the toxicity of ions in solution
- **Increase in crop yields**

The experimental study: Organic and mineral amendment and fertiliser

- ❖ **Alkali amendment: Gypsum CaSO₄. 2H₂O**
- ❖ **Acid Amendment: Ferrous Sulphate FeSO₄**
- ❖ **Organic matter amendemnt: Farm Manure**

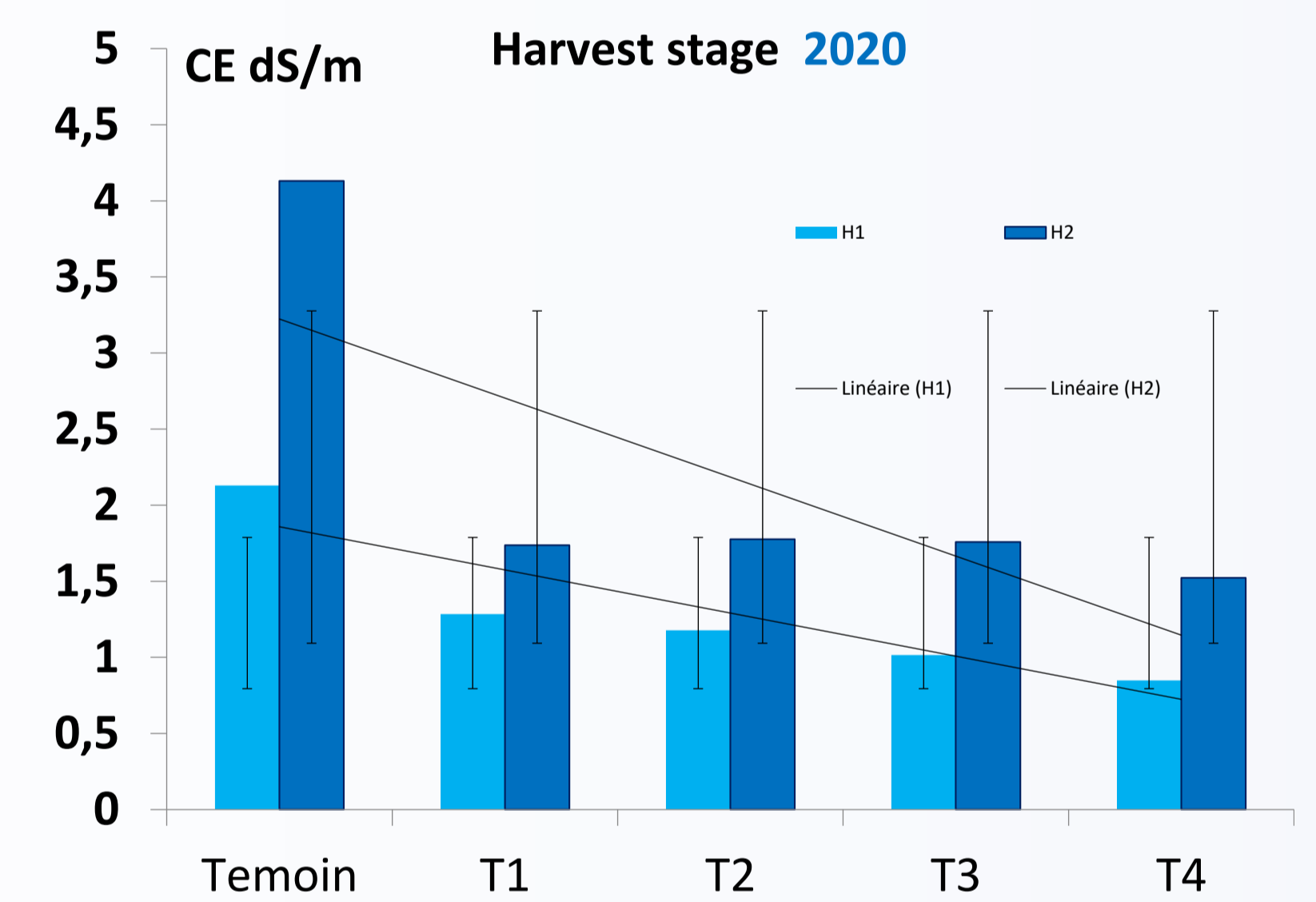
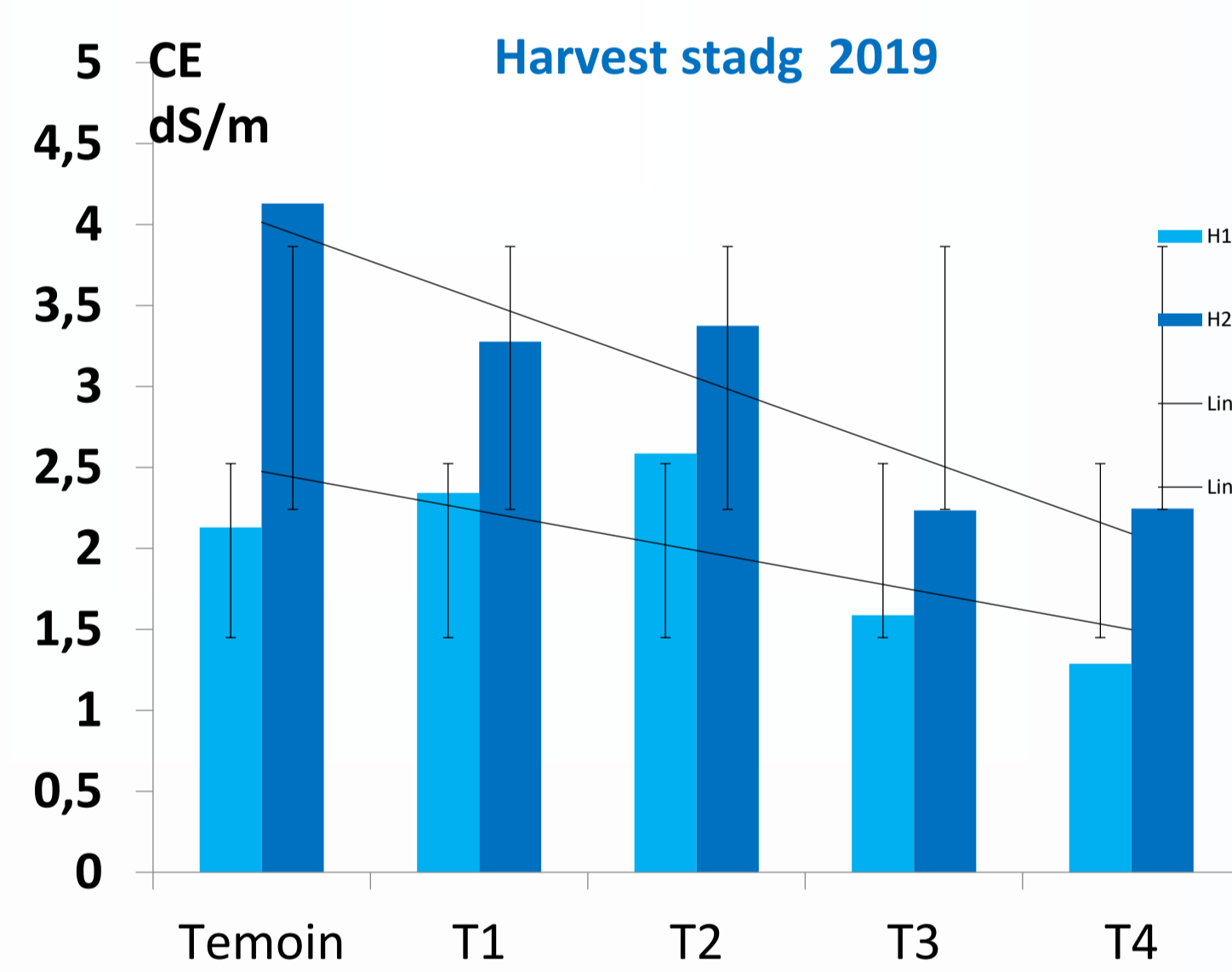
- T1: Farm manure + Sand
- T2: Farm manure + Sand + CaSO₄
- T3: Farm Manure + Sand + FeSO₄
- T4: Farm Manure + Sand + 1/2(CaSO₄ + FeSO₂)

Organic and mineral fertilisers

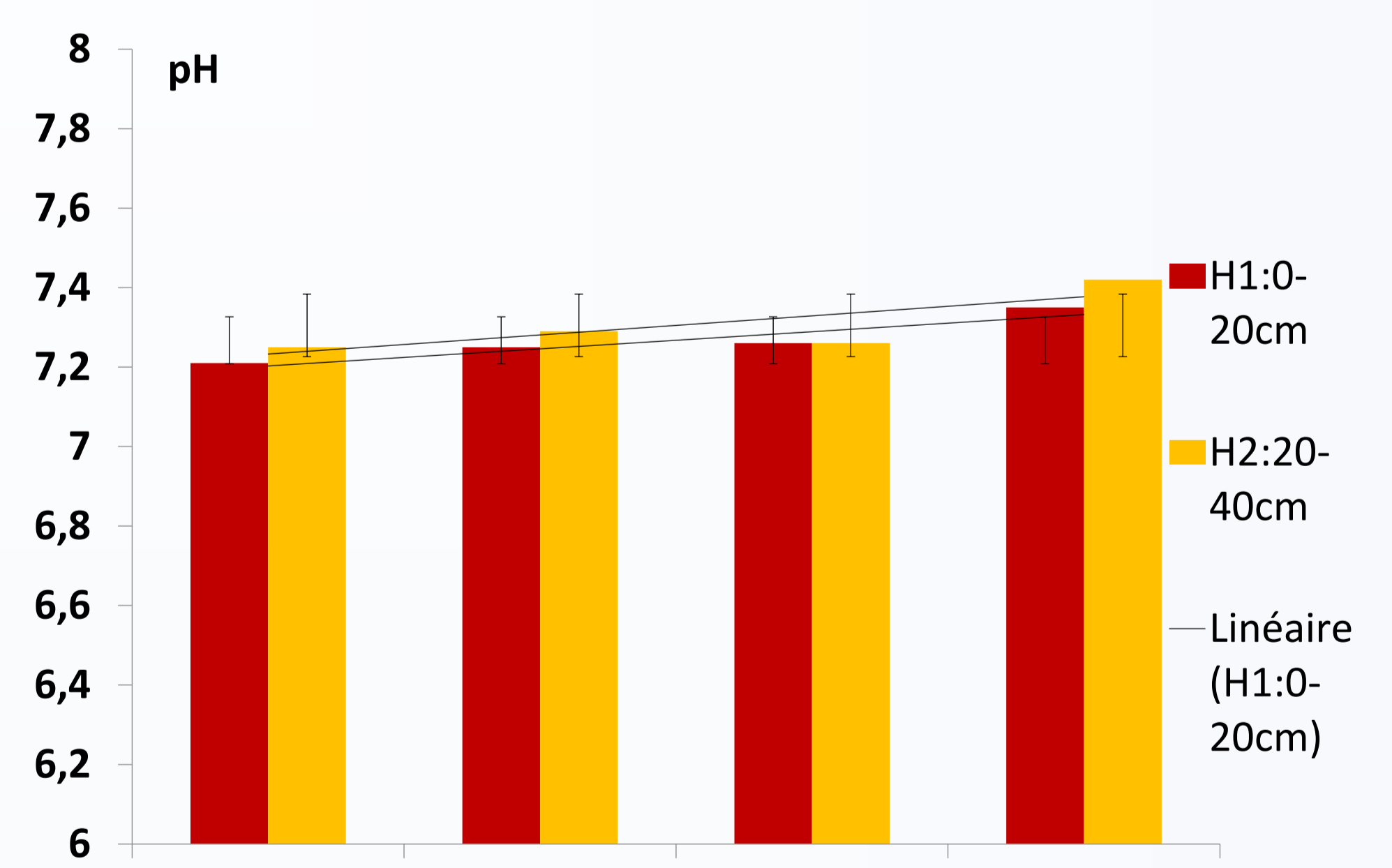
Farm Manure	120 m ³ /ha
Gypsum	3750 kg/ha
Ferrous Sulphate	4600 kg/ha
Sand	60000 kg/ha

Physical and chemical properties of the soil

Soil deep (cm)	pH (1/5)	EC (1/5) (ms/cm)	SAR (mmol/L)	Total salt (g/kg)	ESP (%)	O.M (%)	Gypsum %
0 - 20	7,23	2.25	8			6,10	17.54
20 - 35	7,35	3.36	9			5,80	18.61

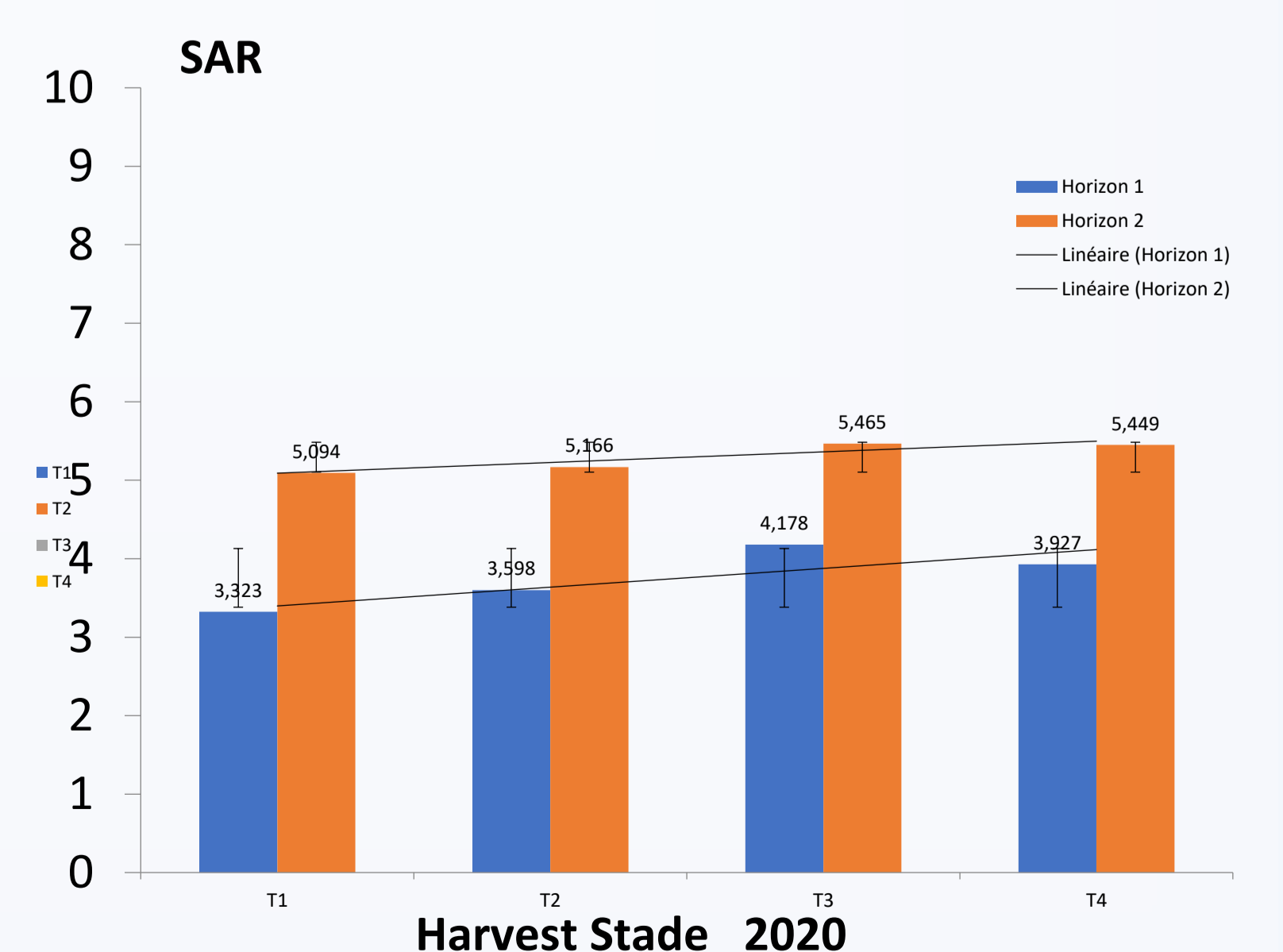
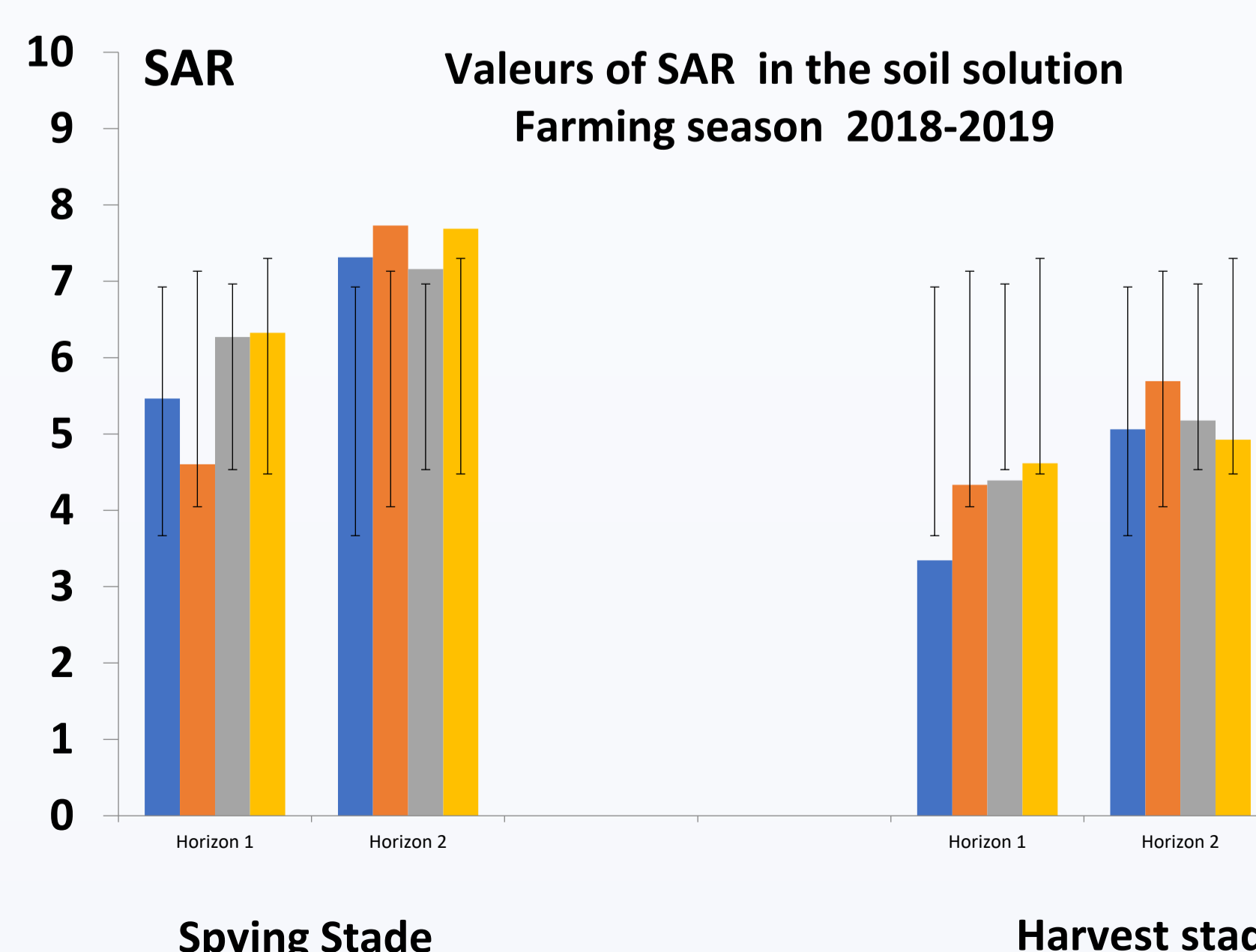


Changes in soil salinity in fertilised under sprinkler irrigation 2019 and 2020



Valeurs du pH dans les parcelles F6(N8N9N10) au stade montaison Mars 2020

Valeurs of SAR in the soil solution Farming season 2018-2019



SAR parameter change in the soil of different amendments during the 2019 and 2020 growing season