Nitrogen Management

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Advancing Every Acre™

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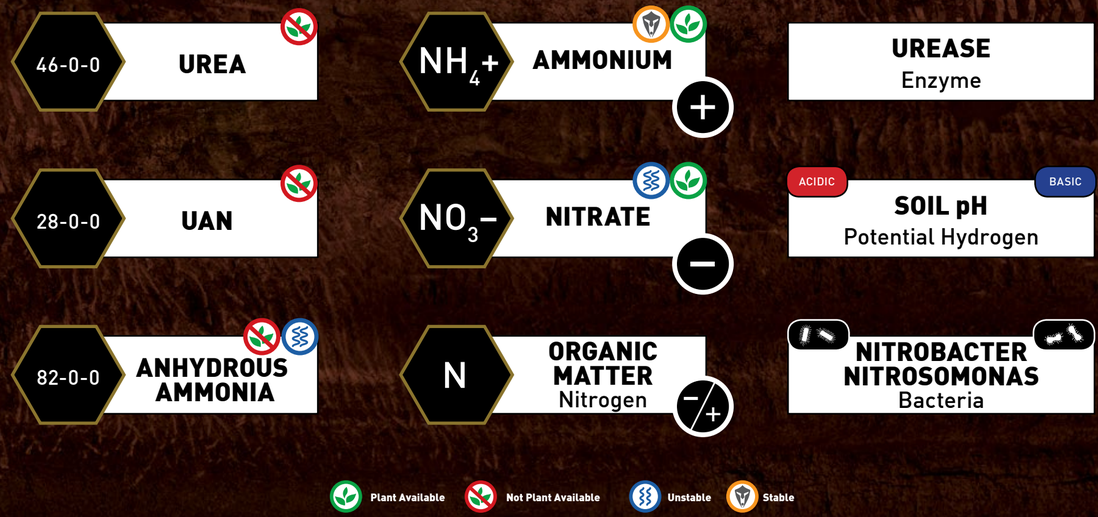
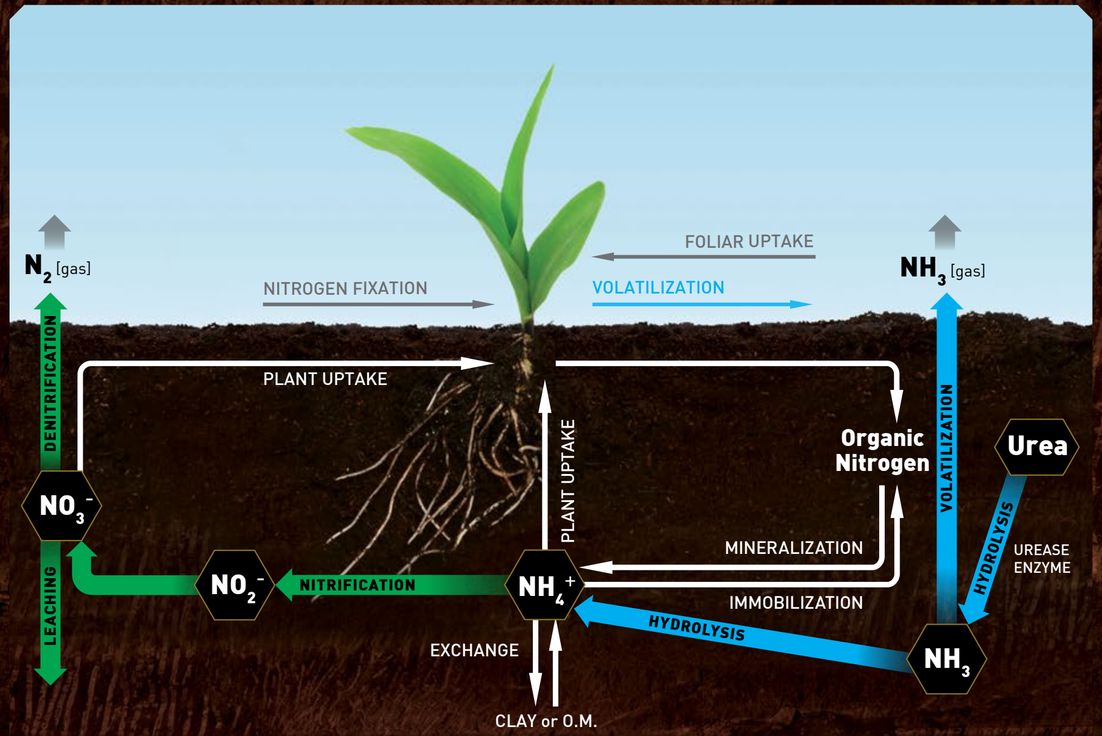
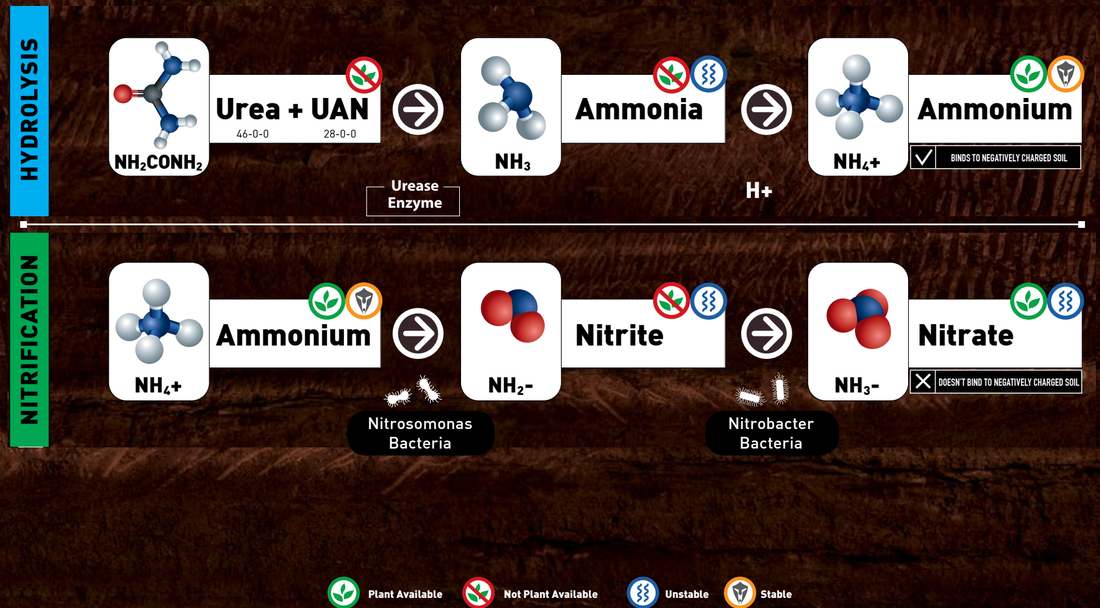
How does all this TERMINOLOGY RELATE to NITROGEN MANAGEMENT?



NITROGEN CYCLE



The NITROGEN CONVERSION PROCESS



NEGATIVELY CHARGED SOIL and PLANT AVAILABLE FORMS of NITROGEN

SOIL

Negatively Charged

Both **Clay Content** and **Organic Matter** have a large number of negative charges on their surface, thus attracting cation elements. At the same time they also repel anion elements ("like" charges).

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CRASH COURSE on NITROGEN

When a fertilizer company manufactures nitrogen fertilizer, it is taking nitrogen from the air and converting it to a form plants can eventually use. The first step to creating any form of Nitrogen fertilizer is to make ammonia (NH_3), which is 82% Ammonia Nitrogen (82-0-0).

82-0-0 ANHYDROUS AMMONIA

Process where Nitrogen from air is added to hydrogen under high pressure + temperature

46-0-0 UREA

Manufactered by reacting NH_3 (Ammonia) with CO_2 + water

28-0-0 UAN

Manufactured by dissolving Urea + Ammonium Nitrate in water.
Amide N = 14%
Ammonium = 7%
Nitrate = 7%

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The PROPER AMOUNT of NITROGEN is IMPORTANT

N

Nitrogen Deficiency

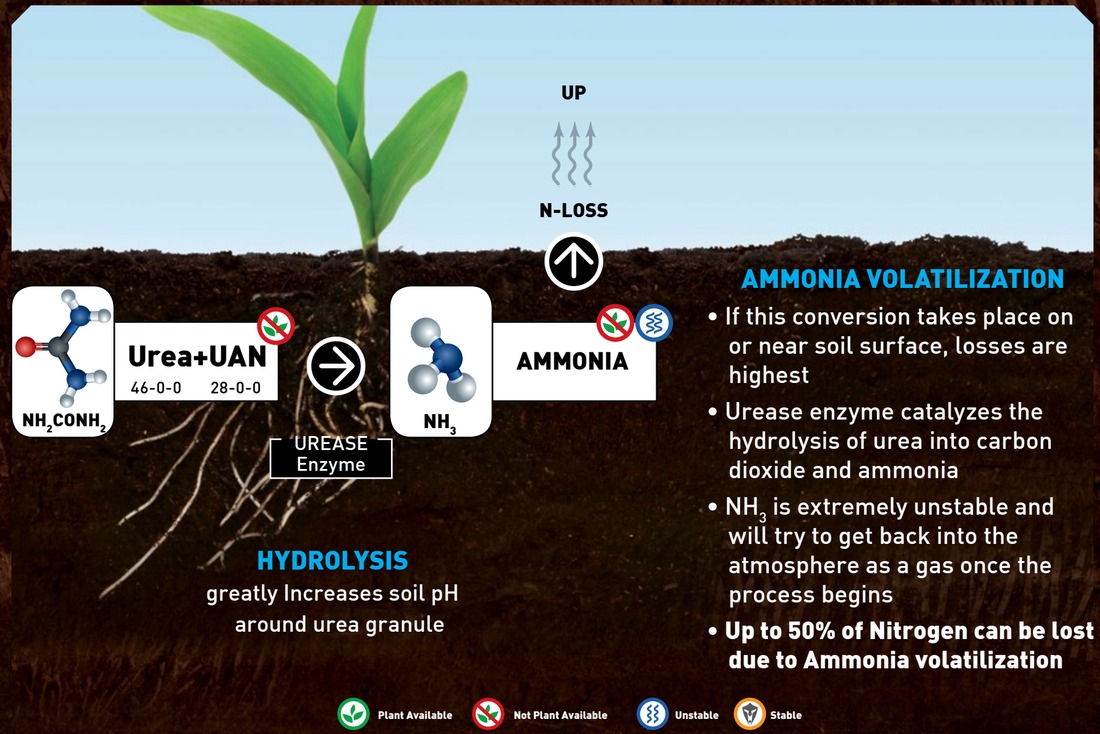
- Poor plant growth and leaves that are pale green or yellow due to inability to make sufficient chlorophyll
- Low Protein Content
- Nitrogen is a major component of amino acids, the building blocks of proteins, and the plant

N

Excess Nitrogen

- Can cause increase in lodging, excess foliage growth, and nitrate leaching into ground water
- Law of Diminishing Returns
- Can lead to other nutrient imbalances and could open the plant up to disease

VOLATILIZATION

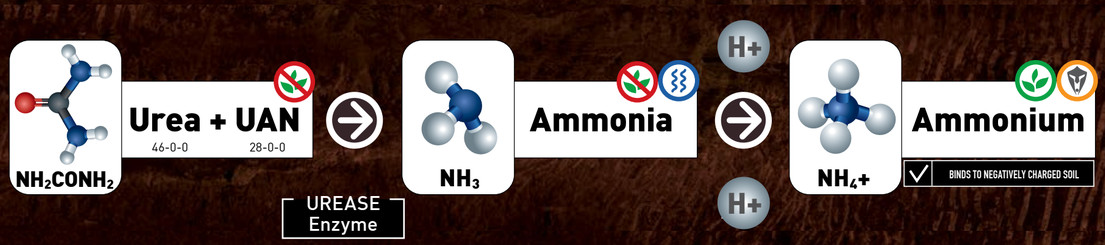


AMMONIA VOLATILIZATION

- If this conversion takes place on or near soil surface, losses are highest
- Urease enzyme catalyzes the hydrolysis of urea into carbon dioxide and ammonia
- NH_3 is extremely unstable and will try to get back into the atmosphere as a gas once the process begins
- **Up to 50% of Nitrogen can be lost due to Ammonia volatilization**

HYDROLYSIS

Ammonia needs to find hydrogen to stabilize as Ammonium.



HYDROLYSIS
greatly Increases soil pH
around urea granule

CONSIDERATION of HYDROLYSIS

- Soil pH
- Soil Moisture
- Soil Temperature (-20ºC)
- Thatch Cover — 20-30 times higher urease concentration than underlying soil*
- Placement & Concentration

* https://umanitoba.ca/faculties/afs/agronomists_conf/media/Fernandez_NitrogenAdditivesWinnipegDec152016.pdf

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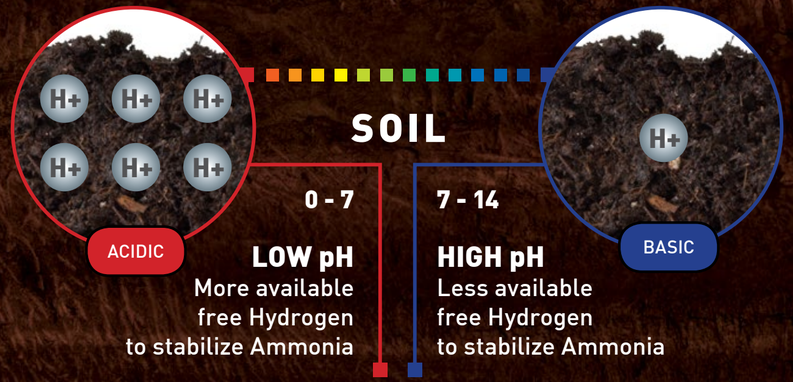
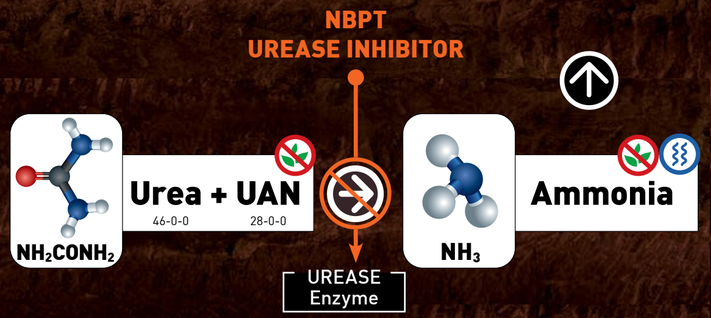
WHY SOIL pH is IMPORTANT



There can be a wide variance between soils, even within the same field. Some soils have a higher potential for losses based on the pH.

Less potential losses are associated with low pH soils than high pH, due to the amount of Hydrogen available in each soil.

NBPT UREASE INHIBITORS (N-butyl-thiophosphorictriamide)



- NBPT inhibitors minimize the urease enzyme activity during the hydrolysis of urea/UAN
- NBPT inhibitors are capable of reducing N loss as ammonia by up to 90% *
- Urease enzyme remains active in the soil as cold as -20°C
- Helps retain more Nitrogen in root zone

* Results are dependent on a number of factors, including soil conditions, temperature and moisture

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When to CONSIDER an NBPT STABILIZER?

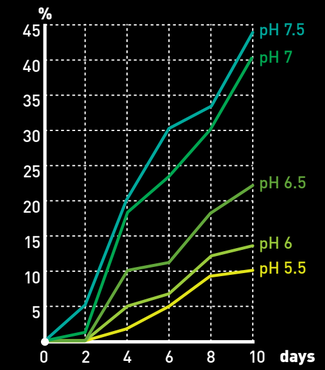
HIGH SOIL pH

High soil pH means less Hydrogen to stabilize ammonia. Using an NBPT slows down the conversion of urea to ammonia gas, extending the time available for ammonia stabilization to 13-28 days.

% Volatilization based upon soil pH [1]

Untreated surface applied urea

Soil pH					
	5.5	6	6.5	7	7.5
Days	% of Added N Volatilized				
0	0	0	0	0	0
2	0	0	0	1	5
4	2	5	10	18	20
6	5	7	11	23	30
8	9	12	18	30	33
10	10	13	22	40	44



- Ammonia (negative charge) needs to bind with Hydrogen (positive charge) to form ammonium
- Hydrolysis process can spike pH 2 to 3 points (ie. pH 5 can go to 7.5 which is still prone to loss)

[1] Overdahl et al., 1960. Soil Sci. Soc. Am. Proc. 24:87-90

NITRIFICATION

With appropriate soil temperatures (starts at 4ºC) and biological activity, Ammonium starts to convert to Nitrite and the process begins.

CONSIDERATION of NITRIFICATION LOSSES

- Soil type (CEC)
- Soil moisture
- Soil temperature: Nitrosomonas and Nitrobacter bacteria will remain active in soil as low as +4ºC

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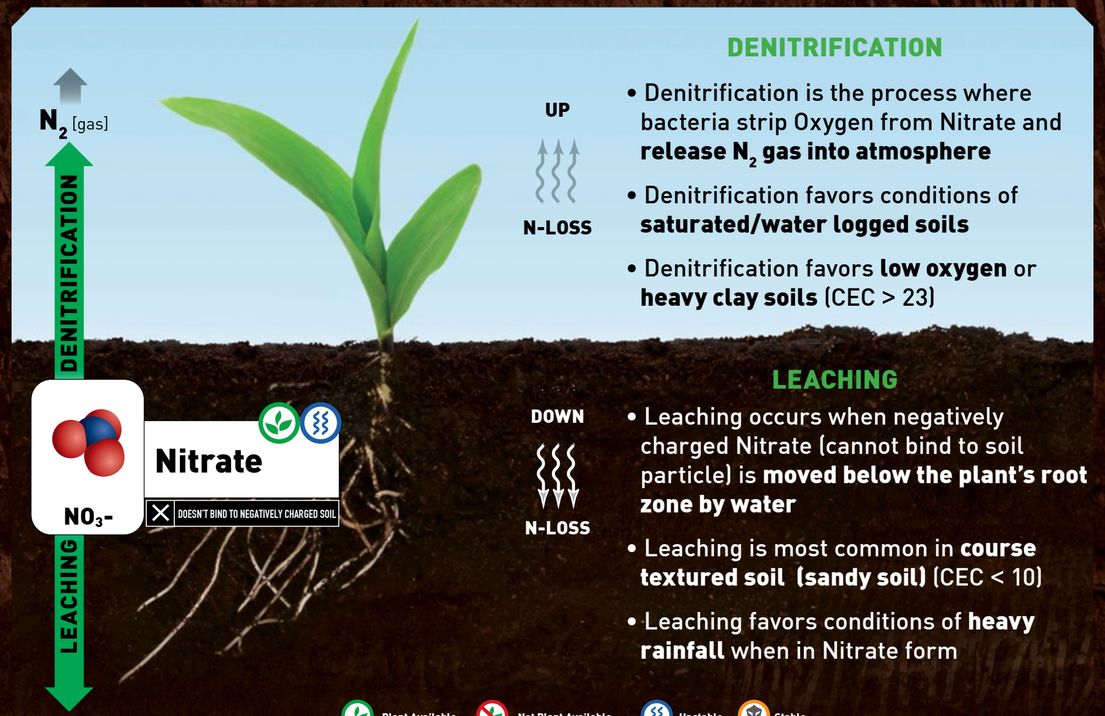
POTENTIAL LOSS MECHANISMS of NITRATE



DENITRIFICATION

- Denitrification is the process where bacteria strip Oxygen from Nitrate and **release N_2 gas into atmosphere**
- Denitrification favors conditions of **saturated/water logged soils**
- Denitrification favors **low oxygen** or **heavy clay soils** (CEC > 23)

LEACHING

- Leaching occurs when negatively charged Nitrate (cannot bind to soil particle) is **moved below the plant's root zone by water**
- Leaching is most common in **course textured soil (sandy soil)** (CEC < 10)
- Leaching favors conditions of **heavy rainfall** when in Nitrate form

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NITRIFICATION INHIBITORS

- Nitrapyrin, DCD, and DMPP products work by inhibiting the activity of the Nitrosomonas bacteria.

- Nitrosomonas and Nitrobacter bacteria will remain active in the soil as low as +4°C

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When to CONSIDER NITRIFICATION INHIBITORS?

- +t°C — Nitrification inhibitors work best in early fall where the conversion of Ammonium to Nitrate can still take place due to warmer soil temperatures
- Saturated/Water logged soils
- Course textured soils prone to leaching
- Long season crops
- 20-70 days — Active in the soil 20 to 70 days

CONSIDERATIONS when APPLYING UREA, UAN, or NH_3

1. Soil Type, pH, Moisture, Organic Matter
2. Nitrogen Placement and Concentration
3. Thatch Cover - 20 to 30 times higher urease concentration than underlying soil [1]
4. **HYDROLYSIS** soil temperature: Urease Enzymes remain active in the soil as cold as -20ºC [2]
5. **NITRIFICATION** soil temperature: Nitrosomonas and Nitrobacter Bacteria will remain active in soils as low as +4ºC [3]

[1] https://umanitoba.ca/faculties/afs/agronomists_conf/media/Fernandez_NitrogenAdditivesWinnipegDec152016.pdf

[2] Enzyme Activity in Soils at Subzero Temperatures, J.M. Bremner & M.I. Zantua; Stability of Urease in Soils, M.I. Zantua & J.M. Bremner

[3] Ammonia Oxidation in NitroSomonas at NH_3 Concentrations near Km : Effects of pH and Temperature, Joost Groeneweg et al 1994; www.biocanlabs.com/nitribactfacts.html

LEARN MORE about NITROGEN MANAGEMENT

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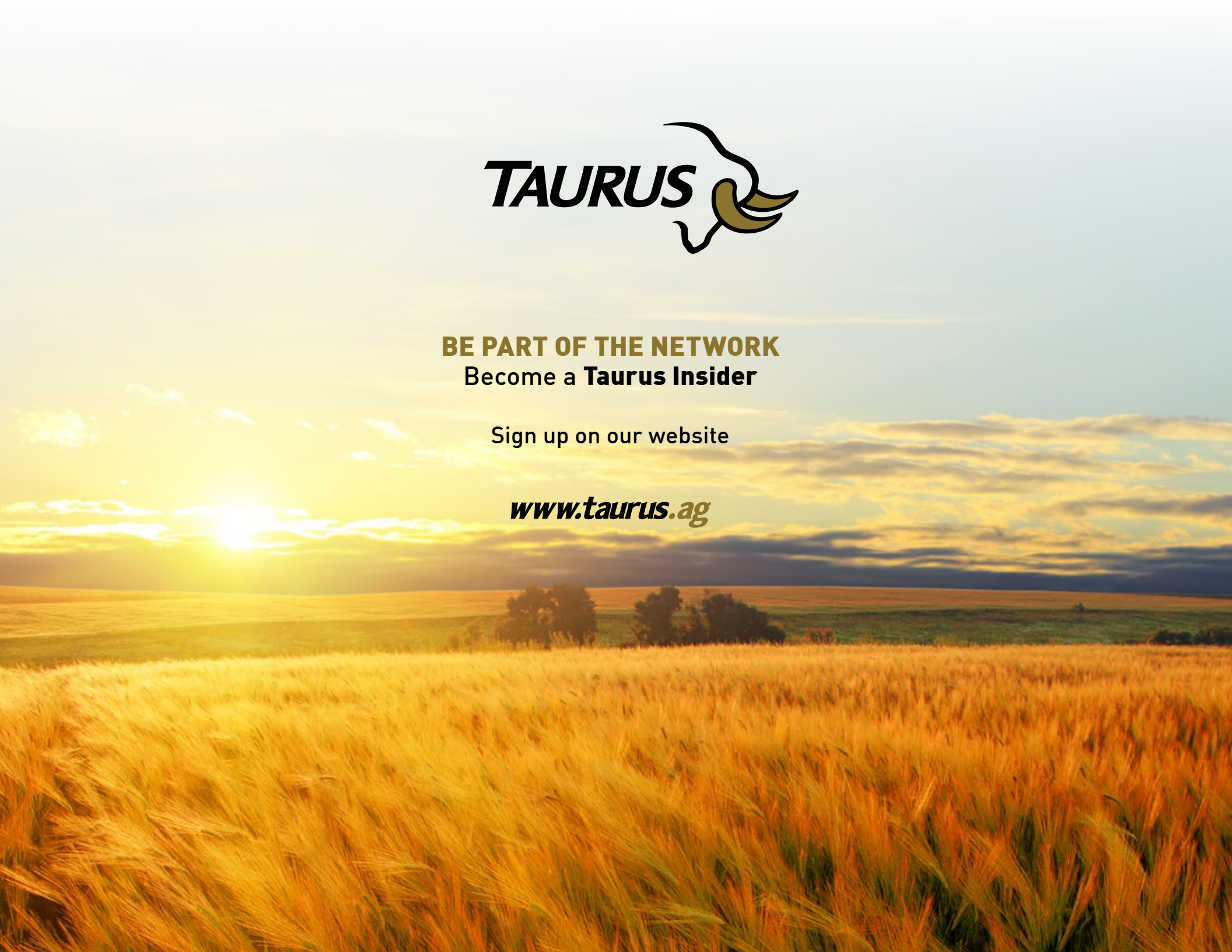
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