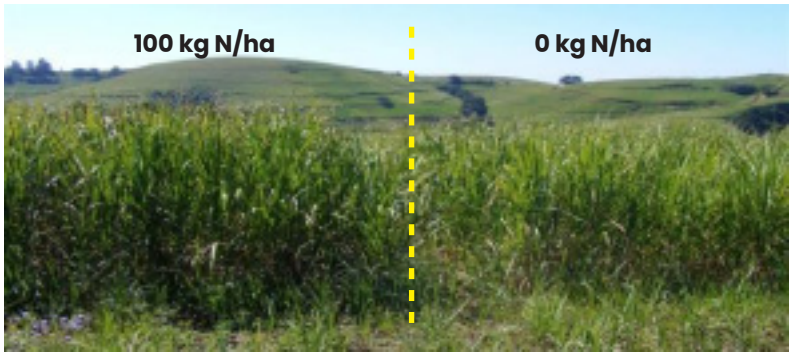
Information Sheet

7.2 Nitrogen management

Nitrogen (N) is one the most commonly applied nutrients in sugarcane and is required in relatively large amounts by the crop. Typically, sugarcane requires between 1.2 and 1.8 kg of N/ton of cane, but high yield crops (>100 t c/ha) can use as little as 0.6 to 1 kg of N/ton of cane). Nitrogen is required for photosynthesis and sugar production. Adequate supply is associated with vigorous growth. Careful management of N is necessary to prevent both sugar yield and nutrient losses.

Deficiency symptoms

- Light green to yellow leaves from the base of the plant (older leaves first) upwards, often with necrosis (death of tissue) on the tips and edges of older leaves.
- Thin, stunted stalks, reduced stooling, reduced tillering and roots and stalks have low biomass.
- Poor uptake of other essential nutrients.



Examples of N deficient sugarcane.

Impact of excess nitrogen on the crop

- Leads to excessive leaf growth and can cause lodging.
- Delays maturity (extends growing period).
- Reduces sucrose levels and juice purity.

Additional note on environmental impacts:
Excess N can also lead to high leching and run-off losses that lead to pollution of water bodies and may promote higher gaseous N losses that contribute to green-house gas emissions and also promote great soil acidification.

Nitrogen losses and transformations

There are several processes in the soil that can both change the form of the nutrient and affect its availability or result in permanent losses (i.e. wasted N):

- **Gaseous losses:** As much 50-80% of applied N can be lost as ammonia gas. This is typically associated with urea fertiliser. Also, in poorly aerated soils (waterlogged and poorly drained soils), nitrate-N can be converted by soil bacteria to nitrous and nitrogen gases that can lead to substantial N losses.
- **Leaching:** Occurs when nitrate in the soil moves to soil depths below the rooting zone due to downward water flow in freely draining sandy soils.
- **Run-off and erosion:** When there is run-off/erosion from fields, applied N can be washed-away as dissolved N (in solution) or particulate N (bound to clays or organic matter).
- **Other transformations:** N availability can be affected by N-lockup (immobilisation – the N used by microorganisms that reduce plant availability) and N-release (mineralisation – the microbial release of N from organic matter).

Planting N-fixing legume green manure crops is a useful strategy to increase soil N.

Factors affecting nitrogen application

- **Organic Matter:** Organic matter can supply considerable amount of N to the soil. Therefore, soils with higher organic matter will require lower N application. Soils have been grouped into four N-categories based on organic matter and clay content (see page 4). Lower N recommendations are given as the soil N-category increases.
- **Target yield:** For a given N-category, the higher the yield, the greater the amount of N that is required.
- **Crop cycle of cane (plant or ratoon):** Ratoon crops respond better to N than plant crops.
- **Use of legume green manure during replant fallow:** Legumes contribute N to the soil. Where they are grown prior to replant, N rates can be reduced.
- **Ammonia volatilisation risk:** Where a risk is identified, non-urea or enhanced efficiency products are advised.

Situations where reduced N is recommended

Nitrogen recommendations should be reduced where specific growth-limiting factors can be identified such as:

- Where **pest or disease** are causing yield decline.
- Under **drought conditions**, as this is likely to trigger pest infestation, particularly stalk borers and use of N by the crop is limited.
- If there is evidence of **thrips or aphid** infestation – treat the infestation before applying N.
- **Waterlogged** soils.
- Where soils are **shallow** (20 to 40cm; e.g. Mispah form).
- When **rainfall is below average** and leading to lower yields.
- If other **soil constraints** are limiting yield potential (e.g. acidity, compaction, salinity/sodicity).
- Where **fertigation** is practised, there is scope for reducing the N recommendation by 20 - 30% due to improved N use effciency.
- If other **N-containing ameliorants** are applied to the soil (e.g. manures, chicken litter).
- The sugarcane is to be harvested at a **younger age** than usual and at a naturally low sucrose period.

Situations where additional N may be required

Where **rainfall has been excessive** following fertiliser application (especially on free draining and sandy soils), **leaf samples** should be taken to establish whether additional N is needed. You can also use **N-monitor plots** to assess the need for additional N applications. If **yield target was underestimated** for that season, then additional N may be required.

SASRI N application recommendations are based on the use of a reliable laboratory service that considers crop yield, management soil factors and uses the best practices derived from the crop response trials. N monitor plots and leaf analysis are very useful tools to help guide topdressing application rates where N is split.

Base N application rates (kg/ha) for different N-category soils and target yields for plant (P) and ratoon (R) crops used in SASRI N-fertiliser recommendations

In the absence of a topsoil fertility analysis, these can be used as a general guide as long as the fields N-category, along with yield target and crop cycle, are known. SASRI recommendations include further adjustments for additional management factors.

N-category class			Yield target (t cane/ha)													
			75		90		100		125		150		175		200	
N-Cat.	SOM%	Clay%	P	R	P	R	P	R	P	R	P	R	P	R	P	R
1	<2	Any	110	140	130	160	140	170	165	195	190	220	215	245	215	245
2	2–4	<35	90	130	110	150	120	160	145	185	170	210	195	235	195	235
3	2–4	≥35	60	100	80	120	90	130	115	155	140	180	165	205	165	205
4	>4	Any	45	80	60	100	70	110	95	135	120	160	145	185	145	185

General guidelines for the application of N in sugarcane on a PLANT cycle

Region	Application guidelines
All regions	**Summer plant** • At planting, apply a fifth to a quarter of recommended N in the furrow and cover with soil thereafter. • About 10-12 weeks later, top-dress the balance, preferably over the row area.
	Winter plant • At planting apply a fifth to a quarter of the recommended N in the furrow and cover with soil thereafter. • Top-dress the balance, preferably over row area where possible, when the cane is knee-high (30 to 50 cm tall). • This top-dressing should coincide with first spring rains with adequate soil moisture and active plant growth.
	Long-cycle cane (two growing seasons) • An additional application of N may be necessary in these conditions and growing season where long cycle cane is planted or cane is carried-over. Ideally, apply the fertiliser over the row area if the cane stand is accessible, otherwise broadcast. • This top-dressing should coincide with the first spring rains with adequate soil moisture and active plant growth of the second growing season.

General guidelines for the application of N in sugarcane on a RATOON cycle

Region	Application guidelines
All regions	**Spring or summer harvested** • In all areas, top-dress a quarter to a third, preferably on the row and as soon as residues have been spread or tops scattered/raked within two weeks after harvesting the previous crop. • Top-dress the balance, preferably over row area where possible, when the cane is knee-high (30 to 50 cm tall). • Use a 4 - 6 week split on sandy or waterlogged soils where losses such as urea volatilisation, leaching or denitrification are likely and consider using an enhanced effciency fertiliser (urease or nitrification inhibitor) under these conditions.
Irrigated: Northern regions	**Autumn or winter harvested** • Where conditions are mild, winter harvested cane should be top-dressed, preferably over the row area where possible, when the cane is knee-high (30 to 50 cm tall). • During very cold winters when regrowth is slow, N uptake will also be slow and splitting N fertiliser will improve N-use effciency, especially for cane growing on soils with restricted drainage and on other light textured N-category 1 and 2 soils. • Use a 6 - 8 week split according to the harvesting season: • **May-June harvest:** Top-dress a quarter to a third initially, the remainder top-dressed 6 - 8 weeks later. • **July-August harvest:** Top-dress a third to half initially, remainder top-dressed 6 - 8 weeks later. • **September onwards:** Top-dress half initially, remainder top-dressed 4 - 6 weeks later. **Fertigation** • Recommended N application rates can be reduced by 20 to 30%. • Split N into 4 - 6 applications to coincide with crop uptake requirements.
Rainfed: Coast and hinterland	**Autumn or winter harvested** • Top-dress, preferably over the row area where possible, after first spring rains and adequate soil moisture (ideally before the end of August). • Cane cut in the early part of the season (April to May) and grown on N-category 1 and 2 soils could benefit from an early split application of N, provided temperature and soil moisture conditions are adequate. Apply about a quarter to a third initially and the balance after first spring rains and adequate soil moisture (ideally before the end of August). • An additional application of N may be necessary in the second growing season where long-cycle cane is planted or cane is carried-over (see guideline for plant cane).
Rainfed: Midlands	**Autumn or winter harvested** • Top-dress when cane is knee high (30 to 50 cm tall cane) preferably over the row area where possible, following spring rains, but not later than the end of September. • Use a 6 to 8 week split on sandy or waterlogged soils where losses such as urea volatilisation, leaching or denitrification have occurred. • During seasons of high rainfall, leaching or denitrification in soils prone to waterlogging may result in the appearance of yellow, chlorotic cane in the second season of growth of a two-year crop. To minimise the risk of N deficiency, leaf analysis should be used to confirm crop status and requirement. • An additional application of N may be necessary in the second growing season where long-cycle cane is planted or cane is carried-over (see guideline for plant cane).

A vailable nitrogen fertiliser formulations

N-Products	N %	Other%	General Notes	Application notes
Anhydrous/ aqueous NH_3	82	-	• High N, effective N source. • Handling, requires deep placement with covering.	• Use qualified contractor to apply. • Effectiveness reduced on very sandy or very heavy clay soils (soils where closing or sealing of tine furrow not possible).
Urea	46	-	• Cheapest N, good handling and storage. • High risk of gaseous loss if poorly handled.	• Avoid use in alkaline or recently limed soils. • Ensure it covered after application. • Avoid banded surface applications. • Slight moisture will induce gaseous loss.
Limestone/ Calcium ammonium nitrate (LAN)	26-28	Ca:3	• Highly effcient, low acidifying, easy to handle, adds Ca. • High cost, leaching risk in sandy soils.	Generally best form of N, but caution is needed on very sandy soils with high rainfall to avoid leaching.
Ammonium sulphate	21	S:23	• Efficient, provides S. • Acidifying, highcost.	• Often used as acidifying fertiliser in alkaline soils. • Banded application may improve P and micronutrient availability in alkaline soils.
Urea Ammonia nitrate (UAN)	28-32	-	• Liquid product. • Risk of gaseous losses.	Apply through fertigation or liquid handling dispenser.
Ammonium sulphate nitrate (ASN)	27	S:13	• Efficient, provides S. • Acidifying, high cost.	• Often used as acidifying fertiliser in alkaline soils. • Banded application may improve Pandmicro nutrient availability in alkaline soils.
Ammoniated super phosphate (ASP)	3.8	P:12	• N and P together, cheap P. • Acidifying, expensive N.	Furrow application at planting is best.
Ammonium nitrate	34	-	• Effective N source. • Acidifying, cost, possible volatilisation risk under some conditions.	Band or broadcast application suitable.
Mono ammonium phosphate (MAP)	11	P:22	• N and P together,cheap P. • Acidifying, expensive N.	Furrow application at planting is best.

Available nitrogen fertiliser formulations (continued...)

N-Products	N %	Other%	General Notes	Application notes
Di ammonium phosphate (DAP)	18	P:20	• N and P together, cheap P. • Acidifying, expensive N.	Furrow application at planting is best.
Potassium nitrate	13	K:38	• Effective, adds K,not acidifying. • Costly.	Furrow or drip fertigation applications better to lower application rates and cost
Calcium nitrate	16	Ca:19	• Effective,adds Ca, not acidifying. • Costly.	Furrow or drip fertigation applications better to lower application rates and cost.
Enhanced Effciency / Slow release N sources				
Sulphur coated urea	44-46	S-variable	• Slow release N source, reduced gaseous losses. • Cost, N availability can be reduced in drier conditions.	Broadcast or furrow, incorporation still advised.
Urea formaldehyde or polymer coated	44-46	-		
Urease inhibitor urea	44-46	-		
Nitrification inhibitor urea	See label	-	• Slow release N source, reduced leaching losses. • Costly.	
Urease/ nitrification inhibitor urea	See label	-	Combined effects.	

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