



SOUTH AFRICAN SUGARCANE
RESEARCH INSTITUTE



SASIAA
SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION



SASIAA

Symposium 2023:

Sugarcane Variety Production:

NovaCane[®] field management

1



31 October 2023

Peter Tweddle



- *Introduction: The NovaCane[®] (NC) process from lab to field*

- 1. *General field observations of NC*
 - *NC bulking plot concerns*

- 2. *NC Extension questionnaire and feedback*
 - *Conclusions/recommendations/knowledge gaps*

- 3. *SASRI NC project*
 - *Objectives*
 - *SASRI recommendations*
 - *NC field management research*
 - *Observation trials*

- *Acknowledgements*

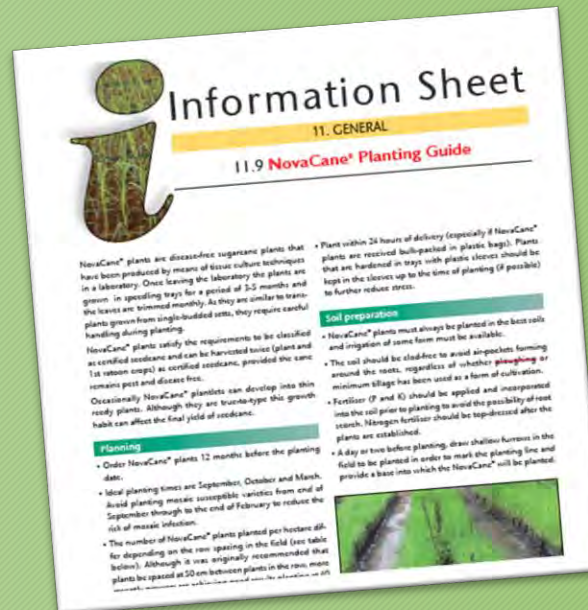
NovaCane[®] production

Laboratory: Tissue culture process

Nursery: Hardening off

Crop establishment:
-Field prep
-Transport
-Handling
-Planting

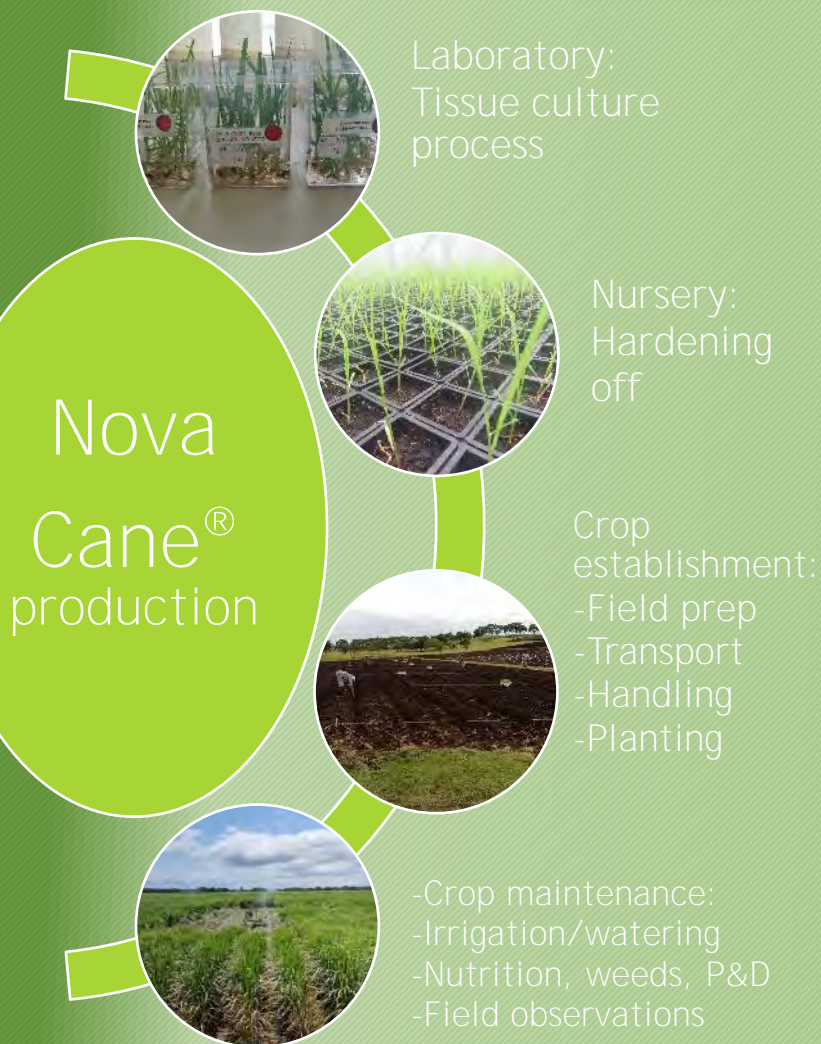
Crop maintenance:
-Irrigation/watering
-Nutrition, weeds, P&D
-Field observations



Benefits of NC

High multiplication rates of:

- Disease free, clean cane
- True to type



Ideal requirements for NC establishment:

- *Healthy, conditioned, hardy, field ready NC plantlets with healthy root system*
- *Fine tilth (well prepared - to depth) and slightly moist soil conditions for planting*
- *Availability of irrigation or supplementary watering capabilities – especially during crop establishment*
- *Ideal weather conditions- cool period, anticipated rainfall*

Growth:

- *Vigorous growth, profuse tillering, erect, sturdy, high stalk population for rapid bulking up*

So how aligned are practices and observations to these ideals?

1. *Thin reedy stalk growth*
2. *Profuse tillering – stabilises with age*
3. *High populations?*
4. *Plantlets may be considered as ‘soft’*
5. *Plantlets need specialized attention*
6. *Flat radial growth habit from the base of the plantlet (tillering laterally)*
7. *Most recent alert: Premature lodging/stool tipping and orange rust was observed under certain conditions...*



Umfolozi irrigated - N76, N77

- Excellent tillering
 - Vigorous growth & biomass accumulation
- but*
- Premature widespread and severe lodging – (stool tipping at 4-5 months age)
 - Orange rust on N76





- *Is this isolated or not?*
- *Reasons for?*
- *What improvements?*

SASRI Project:

Review SASRI's current recommendations for NC[®] plantlet hardening-off, planting and nursery maintenance: (To be informed by a desktop study, interviews, field observations)

Some findings (Umfolozi):

- Excellent growing conditions (Nov plant) and above LTM rainfall for 3 of 4 months
- Vigorous growth – thin stalks
- Radial growth pattern
- Stool tipping predominantly not lodging
- Duplex soils with high clay subsoil – strong but shallow root system
- Overhead sprinkler irrigation
- Point anchor - unlike setts with multiple root anchorage points

Information Sheet
1.4 NovaCane® planting guide

NovaCane® plants are disease free sugarcane plants that have been reproduced by means of tissue culture techniques in a laboratory. Once leaving the laboratory the plants are grown in seedling trays for a period of 3-6 months and the leaves are trimmed monthly. As they are similar to transplants grown from single-tubed sets, they require careful handling during planting.

NovaCane® plants satisfy the requirements to be classified as Certified Sugarcane and can be harvested twice (plant and till ratoon crops) as Certified Sugarcane, provided that some remains free and disease free. Occasionally NovaCane® plantlets can develop into thin ratoon plants that tiller profusely, although they are true-to-type (the growth habit can affect the first yield of ratoon cane).

Planning

- Order NovaCane® plants 12 months before the planting date.
- Ideal planting times are September, October and March. Avoid planting ratoon susceptible varieties from end of September through to the end of February to reduce the risk of mosaic infection.
- The number of NovaCane® plants planted per hectare differs depending on the row spacing in the field (see table). Within one row, space plants 40 cm apart. The closer spacing enables a quicker canopy and better weed control, and a smaller gap if plants die or have to be removed for any reason.

Row spacing (m)	Number of plants per hectare at 40 cm between plants
0.5	25 000
1.0	12 500
1.2	10 417
1.4	8 929
1.5	8 000

Transline row-spacing: Note that it will be necessary to calculate the numbers of plantlets required depending on the specific transline row spacing chosen. For example, for a spacing 0.6m x 1.2m (two cane rows spaced 0.6 m apart alternating with a 1.2m wide traffic area - see SASRI protocol for initial traffic control for an example of this configuration) there will be 11 011 metres of row per hectare requiring 27 777 plantlets at 0.4 m planting spacing.

For a step by step calculation:
To calculate the number of metres of row (the equivalent single row spacing) required for the 0.6 x 1.2 m transline row spacing, divide 10 000 (m² per hectare) by the equivalent spacing = 16 666.66 m
To determine the metres per hectare:
= 11 011 metres
To determine the number of plantlets per hectare:
m) = 11 011 / 0.4 = 27 777 plantlets per hectare.

- Great care should be taken when transporting NovaCane® plants. Vehicles should be covered and the plants should not be exposed to high temperatures. If there are delays in delivery, the containers should be removed from the delivery vehicle, if possible, and stored in a cool place. Use the plantlets if they are to be stored for any length of time.
- Plant within 24 hours of delivery (especially if NovaCane® plants are received bulk-packed in plastic bags). Plants that are hardened in trays with plastic sleeves should be kept in the sleeves up to the time of planting (if possible) to further reduce stress.

Planting

Soil preparation

- NovaCane® plants must always be planted in the best soil conditions of the farm that be available.
- The soil should be checked for soil-borne pests, nematodes, harmful fungi, or other organisms that may be present. If any of these are present, appropriate measures should be taken to control them before planting.
- Use a soil test to determine the soil's nutrient status. If necessary, apply fertiliser to the soil before planting.
- Apply a top-dressing of fertiliser to the soil before planting.
- Apply a top-dressing of fertiliser to the soil before planting.

Planting

- A wooden peg and hammer is required to make the hole for the NovaCane® plant. The hole should be 40 cm deep and 40 cm wide. The hole should be made in the soil before planting.
- If the soil is dry and friable (easily crumbled), a small amount of water will be required to moisten the soil before planting.
- Planting holes should be made in the soil before planting.
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- Planting holes should be made in the soil before planting.

Weed control

- Fields planted with NovaCane® can be either hand-weeded or sprayed with herbicides within 14 weeks of planting. Hand-weeding is intensive when labour is available and the NovaCane® plants are planted in a regular pattern. For the use of NovaCane® plants, hand-weeding is not suitable for the use of NovaCane® plants. Hand-weeding is not suitable for the use of NovaCane® plants.
- Fields with a history of competing grasses should not be planted to NovaCane® plants.

Figure 1: The required planting density

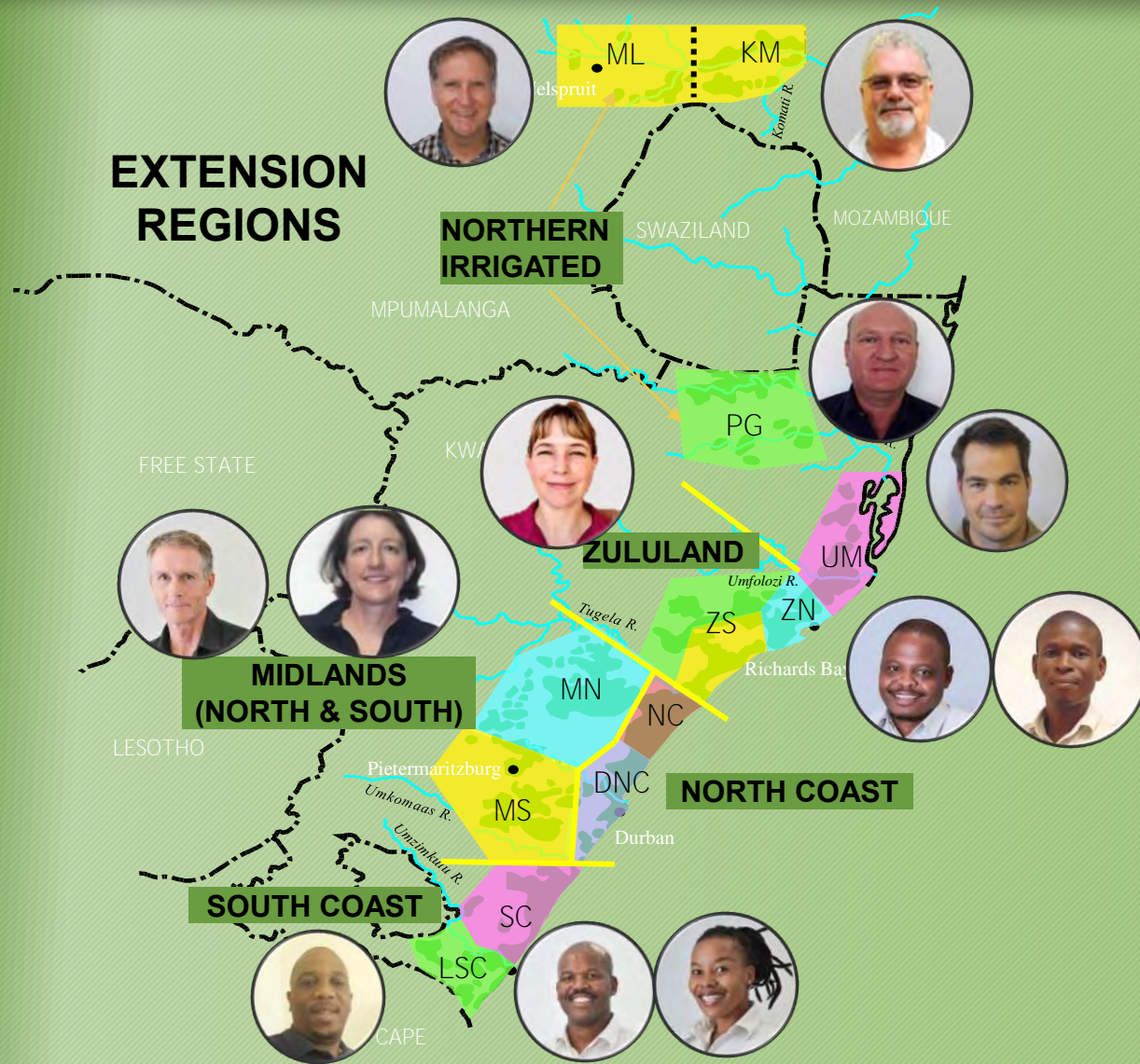
Sandy Snyman (Principal Scientist, Biotechnology) & Towns-Lawson (Extension & Soils Manager) June 2013

Information Sheet

1.4 NovaCane® planting guide



- 12 months lead time for ordering – plant in Sept/Oct or March ideally
- **Timing**
- Hardened off for 3-5 months in speedling trays in a nursery environment
- Plant ASAP (within 24 hours)
- Leave plantlets in trays until ready to plant in the field and prior to field planting
- **Plantlet preparation**
- Avoid transporting in high temperatures – store in a cool place, covered or in shade
- **Transportation**
- Keep plantlets in plastic tray inserts as long as possible to avoid shock (if applicable)
- Plant in best (clod free) soils with fertilizer (P and K) already incorporated into shallow plough
- **Field preparation**
- Nitrogen applied as a top dressing after establishment
- 40cm spacing recommendation
- Depth of planting – up to lowest leaf, consolidate soil slightly
- **Plantlet care**
- Irrigation water capacity is recommended >1L/plant (gel optional)
- Weed control within a week of planting –sprayed to base only due to herbicide sensitivity and avoid fields with creeping grasses



NovaCane® Questionnaire:

12 responses from Extension Specialists regarding their/grower NC experiences:

1. Stalk appearance
2. Are plantlets 'Soft' – reasons for?
3. Lodging issues
4. Growth and tillering
5. Perceived benefits
6. Priority considerations for growers
7. Knowledge gaps
8. Monitoring/feedback of NC varieties and trials going forward



- Speedling trays – preference for 98 cell speedling trays
- Review of trays and liners (to mitigate heat stress and promote better transport and storage)
- Attention to quality of plantlets when received – not root bound or lanky, not unduly stressed but healthy appearance with well developed roots through the medium
- Plant ASAP (within 24 hours) into moist soil, early morning or under cool conditions, and if stored allow to air and moisten regularly while kept in shade conditions
- Plant in best (clod free) soils with fertilizer incorporated and pre-treated for soil pest, following deep soil cultivation with fine tilth, into shallow pre-drawn furrows. Weed and volunteer free fields.
- Depth of planting more important than ideal spacing recommendation - up to lowest leaf, consolidate soil slightly, no J rooting
- Frequent light irrigations or watering capability is recommended >1L/plant (gel optional). Once established, less frequent watering recommended

1. "NC plantlets are always thinner, reedy stalks with higher populations" ...

The general consensus from all ES's:

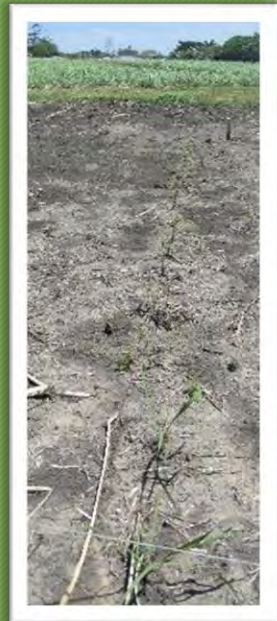
- Yes generally although some varieties are more affected than others
- Notably thinner: N12, N31, N58, N41, N70, N72, N74, N76, N77, N78
- Minimal change: N48, Other? N63, N68, N69, N75



2. "NovaCane plantlets tend to be 'soft;'"

There were distinct regional differences in opinion/observation.

- The northern irrigated areas indicated that the plantlets were not 'soft' while the rainfed areas indicated that the plants were generally 'soft'.
- Varieties: N77 was noted to be softer than N76.
- Requirements: Good soil prep (tilth), hardened trimmed plantlets, unstressed, not root bound, stored in shade, transported suitably, plant into moist soil to sufficient depth, same day planting, not during heat of the day, irrigation/light frequent watering's >2L/plant at planting, overhead better than drip irrigation, avoid fert contact with plantlets



3. “NovaCane plants tend to lodge early and more severely than conventional plantings”

There were distinct regional differences in observations from the ES’s:

- The northern irrigated areas: lodging & stool tipping was **common and mostly severe**. Premature lodging and stool tipping was noted in the NI areas. **Some varieties** tended to lodge more severely than others.

- Hinterland and coastal areas: lodging events not that prevalent, more common on older aged crops. When lodging occurred then generally severe.

- Stool tipping seemed to be a function of **shallow soils** or **frequently irrigated crops** or where there was **rapid growth and above ground biomass accumulation was high**.

- Recommended spacing: Depth most NB, not spacing. Generally 20-25000 plants/ha.

- Varieties prone to lodging: N61,

- Varieties prone to tipping: N65, N77,

- Varieties more resistant to lodging/tipping: N63,



4. “NovaCane plantlets have more vigorous growth and tillering”

There were mixed responses.

- Most ES’s tend to agree on **profuse tillering and high stalk populations**, but it seems that **growth vigor is a function of the variety with some showing slower growth characteristics**. No yields have been captured at this stage. Some ES’s felt that the yields appeared higher, others indicated similar but all were not certain as no trials have been weighed.
- Seems like the **performance may depends on crop establishment efficiency**: minimizing transplant shock, seasonal timing of planting, conditions under which planting happened...
- Varieties noted to have slower growth characteristics: N74, N75, N76, N77, N78
- Good growth performance: N78



5. The advantages of NovaCane outweigh the disadvantages

Yes: disease free, true to type, clean cane.

- A rapid propagation method to get new varieties out to the industry, good option where HWT tanks are not readily available.
- Generally advantageous with provisos being cost, higher management requirements, longer term perspective

6. List of prioritized considerations for growers: All ES's comments combined

- Benefits: Disease free seedcane source, true to type, clean start
- Effort: Higher level of management of plantlet establishment, same P&D and environmental pressures, timing NB, irrigation/watering management is essential, attention to establishment: planting depth, weather and field conditions, soil tilth, high soil potential, clean field, avoid harsh chemicals.
- Curb expectations: Initial appearance: Thinner stalk tendency but reserve judgement till next crop. Collaborators/growers need to be sensitized to differences of NC.

7. Gaps in knowledge: All ES's comments combined

- Time for NC to revert back to thicker stalks of sett material (ratoons)?
- Ideal plug size for quality healthy roots (98 vs 128; shape and tray material)?
- How to improve lodging and stool tipping resistance?
- Knowledge sharing: Need to create a shared environment for **feedback** experiences with NovaCane – **training material** of what to expect regarding NovaCane compared to sett planted material and provide **BMP's** for handling and planting operations.
 - Support for a simple NC evaluation template
 - NC plantlet vs sett planting comparisons (?)
 - SSG's have little experience with NC
 - Farmers seem to be more aware of NC and more tolerant of interim negative traits





SASRI NovaCane[®] observation trial

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Excess N78 plantlets from SASRI NovaCane[®] facility

- Hardened off under shade cloth facilities at SASRI
- Leaves trimmed before planting
- Planted into moist soil, fertilized at planting
- NC plantlets planted at different spacing's and depths and hilled up
- N78 field growth – not as vigorous as setts (adjacent screening trial with multiple varieties)





Replicated trial:
Varying spacing and depths

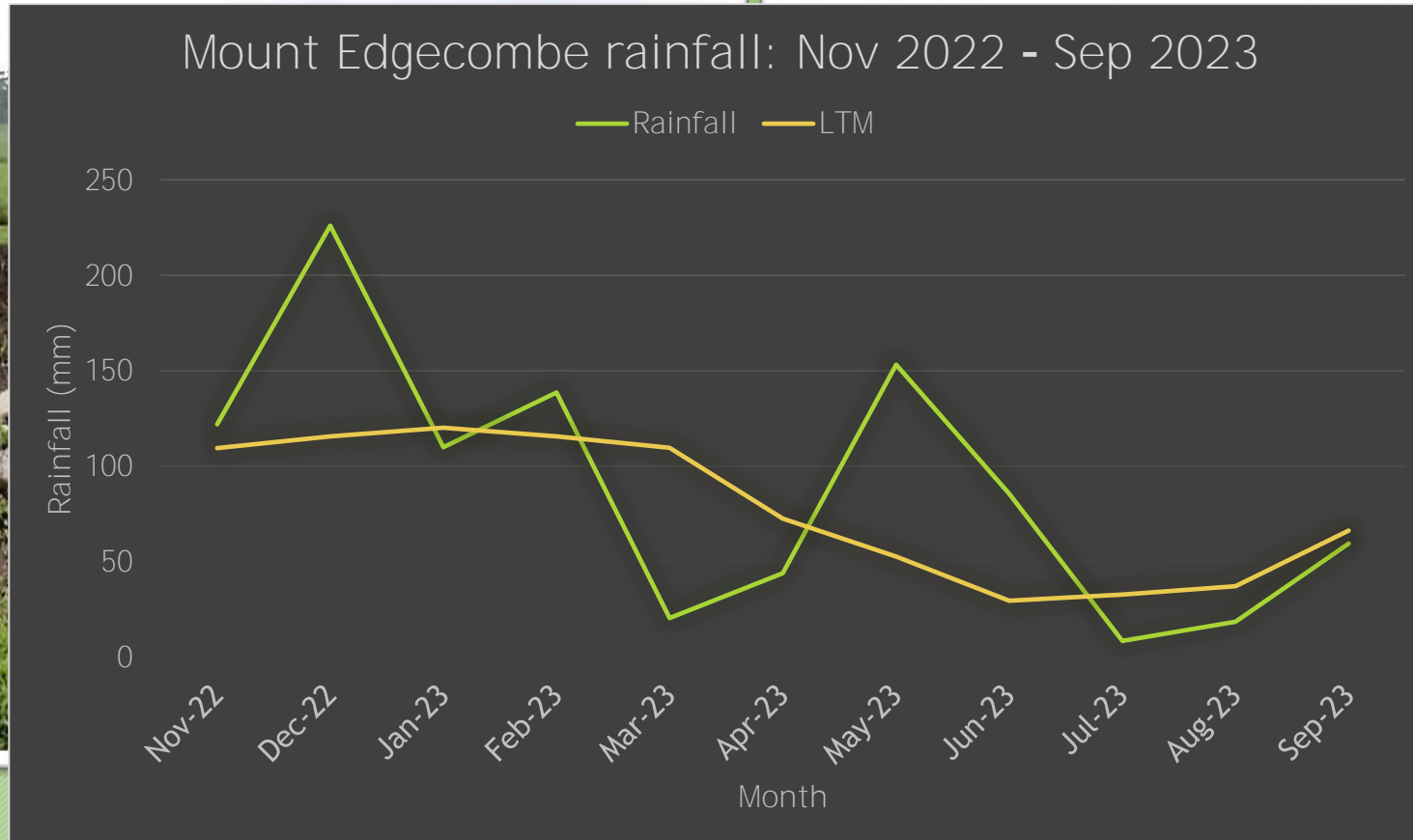
Sub trials:
Varying tray sizes and types

33cm vs 50cm spacing

PLANTING: November 2022



Heavy rainfall: December 2022



- Rainfall across 10 months: 986 mm (14% > LTM of 862mm)

February 2023 (3 months)



March 2023 (4 months)



Hilling up of
observation trial 1



SASRI - trial 1

Varying tray sizes and types

May 2023 (6 months)



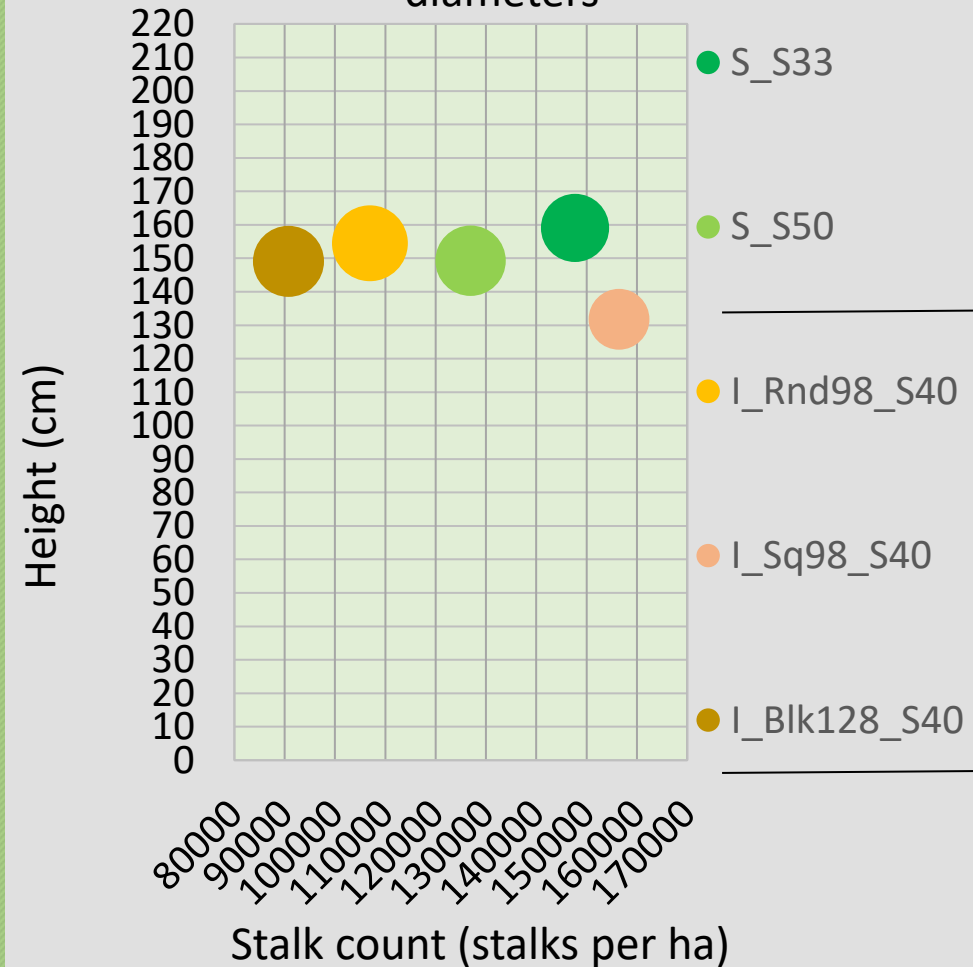
July 2023



June 2023
(7 months)



N78 average stalk heights, counts and diameters



Δ Yield:

↑ 16%

↑ 25%

↑ 40%

Findings so far: 2022 sub trial - different plantlet spacing's and different trays

Disclaimer: 1 block per treatments side by side for observation purposes: Not a replicated trial.

Findings: Spacing's: 33cm planting seems better than the 50cm planting (16% relative yield difference) but uses 50% more planting material,

Eg. (For a 75t/ha yield: Cost of 8000 more plantlets/ha offset by about ±R10000 yield gain).

- 1. Taller height*
- 2. Higher population*
- 3. Thinner stalk diameter*
- 4. Overall higher biomass yield compared to all the other treatments for the sub trial.*

Findings: Tray size and plug shape

- 1. The 98 cell trays performed better than the 128 cells for the same treatment conditions (40% relative better yield estimate)*
- 2. Round cells seemed to perform better than square plug dimension (25% relative better yield estimate)*

Survival rates of N78 plantlets after hardening off at time of transplanting (40 trays):

- Black plastic trays with inserts (98 cell): 84%
- White polystyrene trays (98 cell): 77%





SASRI NovaCane[®] observation trial

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September 2023





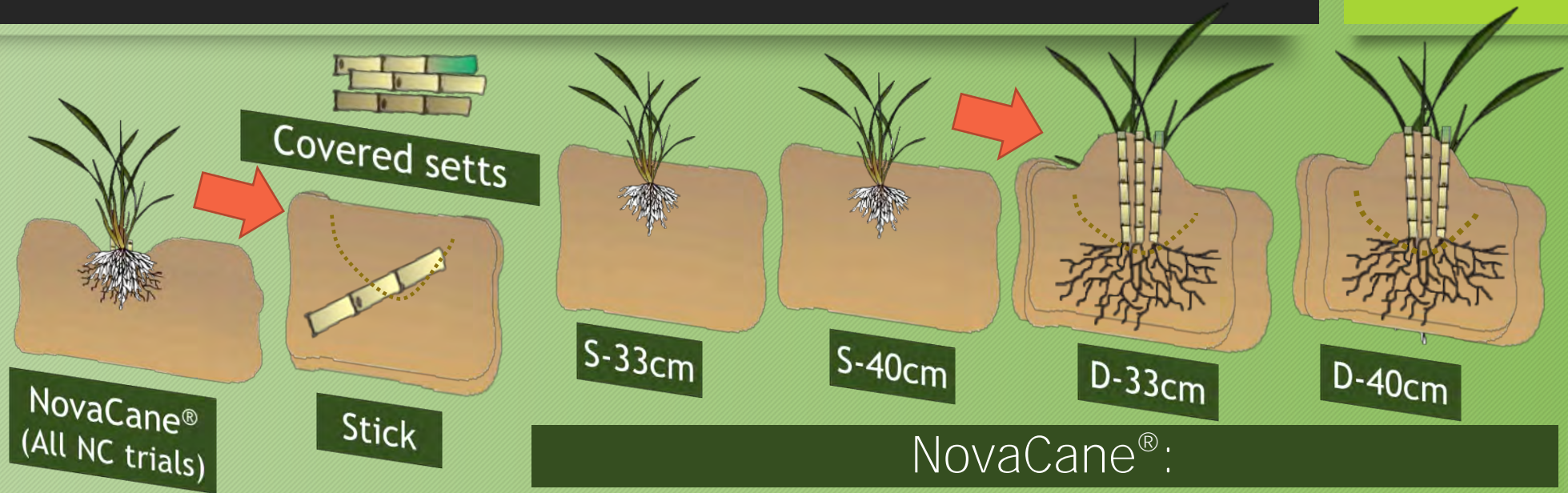
SASRI NovaCane[®] observation trial- roots

30

September 2023



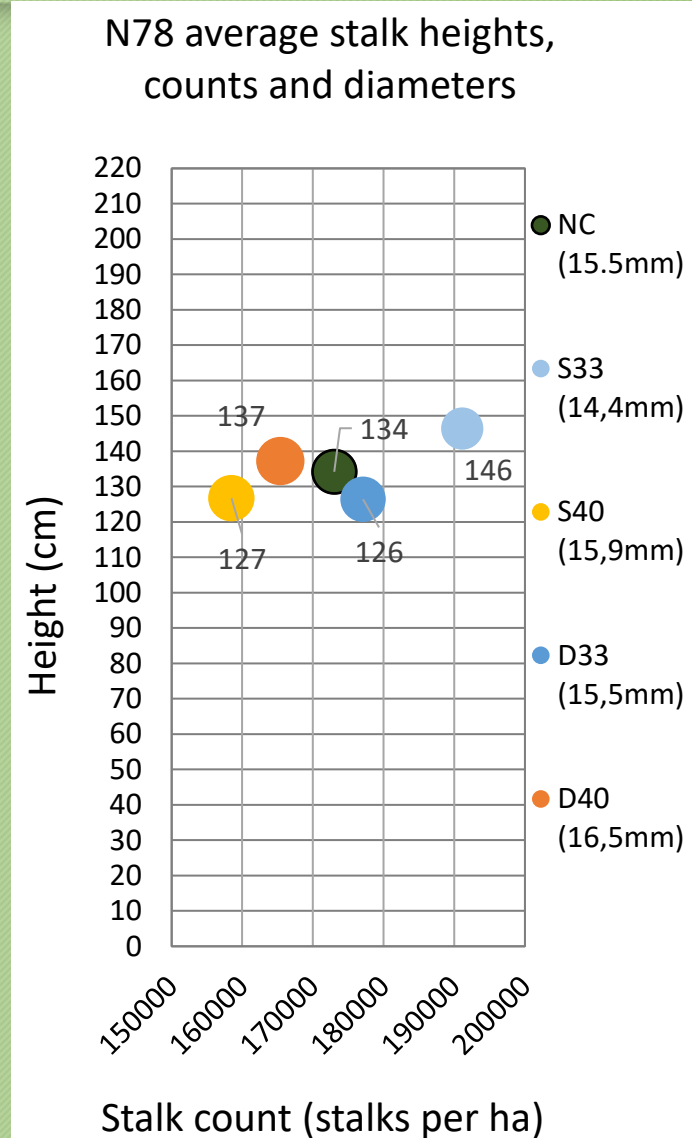
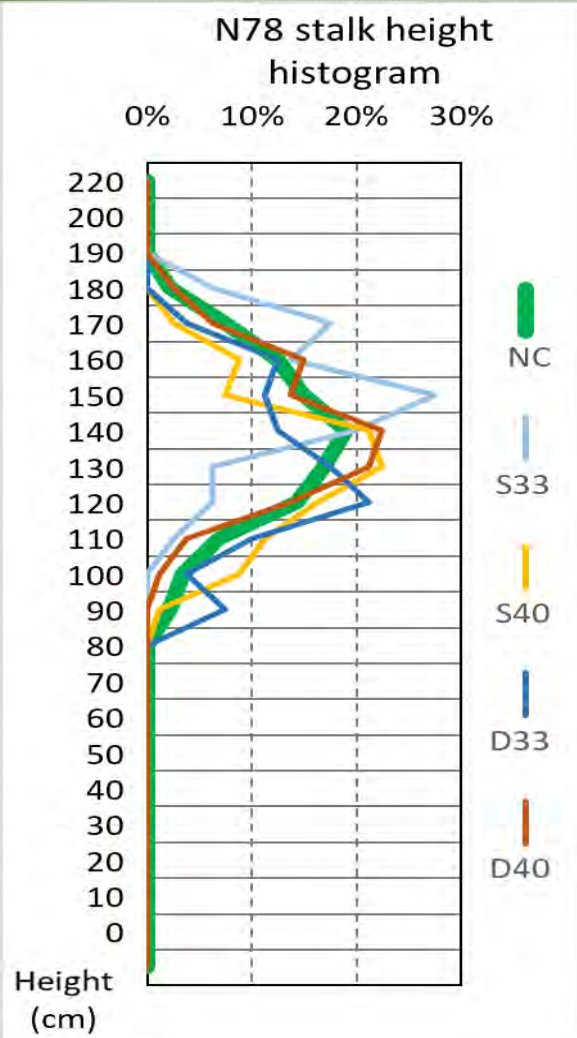
Land prep:



Parameter:	N78 Nova Cane	N78 Stick planted cane	N78 Shallow @33cm	N78 Shallow @40cm	N78 Deep @33cm	N78 Deep @40cm
Height (cm): n>80	134					
Dia (mm): n>32(x3)	15,5	19,3				
Count (#/ha) n>4 (10m)	173029					
Stick length/m	30,3					

±25000 plants/ha

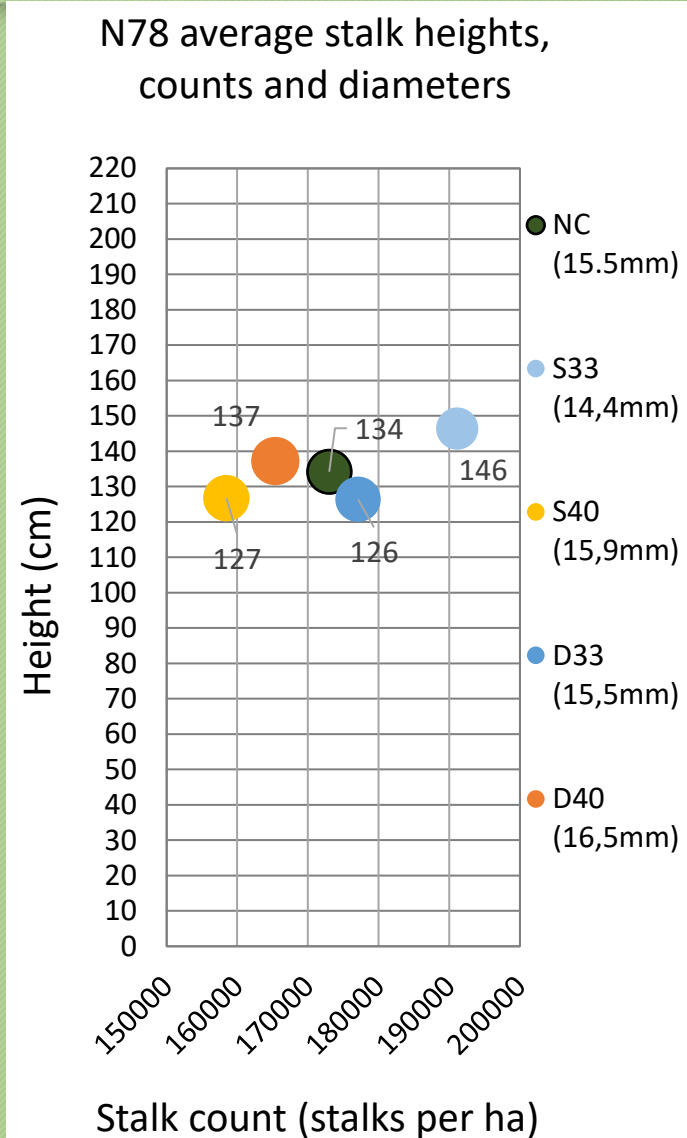
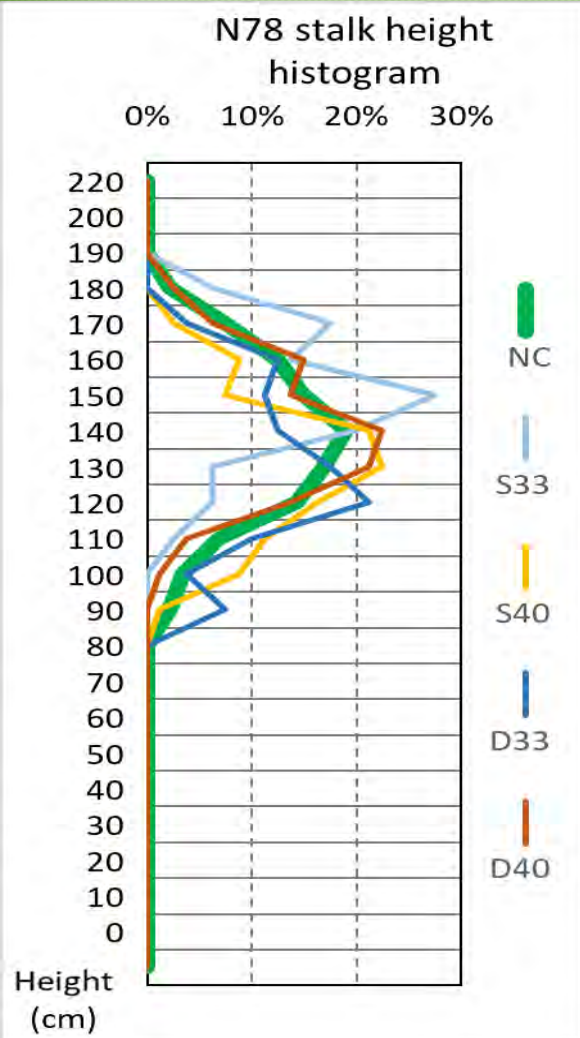
±20000 plants/ha



A two sample t-test was performed to compare means of the groups.

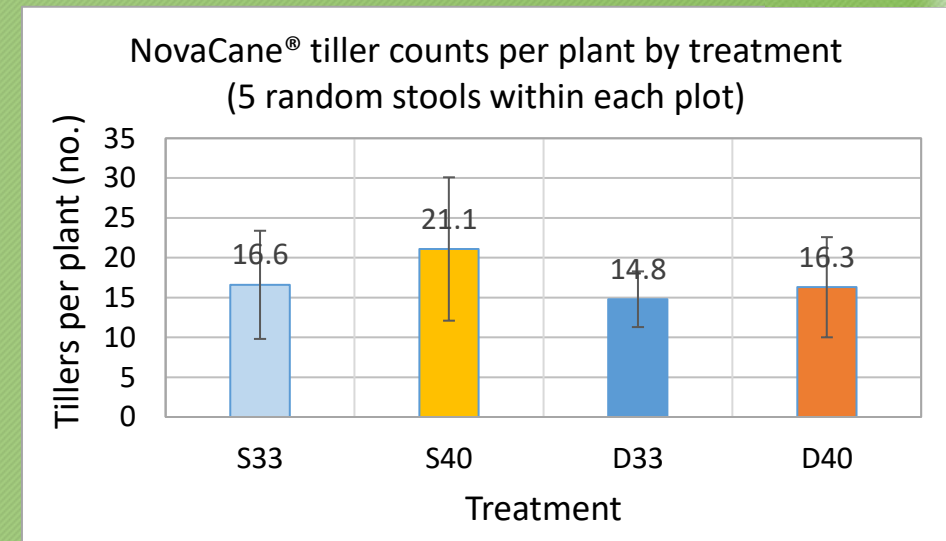
All groups differed significantly from each other*

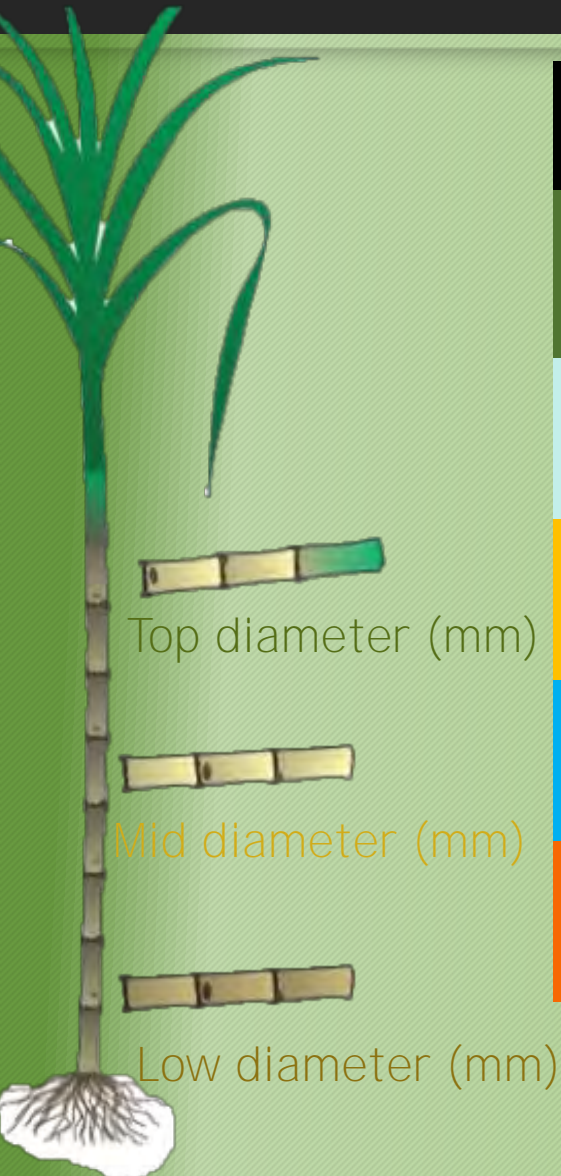
Grp 1	Grp 2	dF	T	P
S33	S40	156	7,3	1,4 E-11*
S33	D33	143	6,5	6,1 E-10*
S33	D40	158	3,5	0,00003*
S40	D33	158	3,5	0,00006*
S40	D40	157	-3,8	9,9 E-5*
D33	D40	147	-3,5	0,0007*



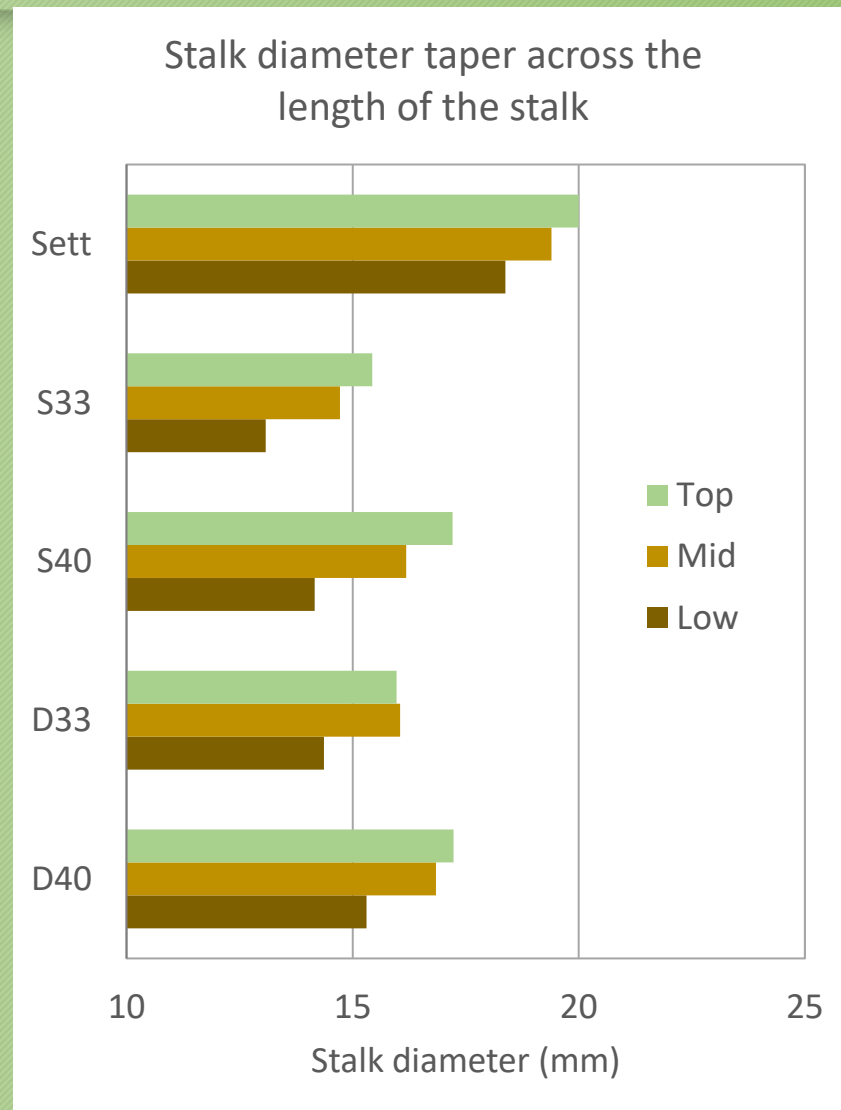
Yield (m³/ha):	33cm	40cm
shallow	45,6	39,6
deep	42,0	48,3

Stick length (m/m)	33cm	40cm
shallow	36,4	26,1
deep	29,1	29,5





Treatment:
Setts
S33
S40
D33
D40



Taper Top/Base (%)
109%
118%
122%
111%
113%

Shallow planting had the WORST taper



Findings:

- 1. N78 seems to have a thicker diameter at the top and seems amplified through tissue culture propagation*
- 2. N78 NovaCane® plantlets had thinner stalk diameters compared to an adjacent sett planted crop (80%)*

In terms of treatments:

- 1. The standard planting depth at 40cm spacing performed the worst of all treatments (current recommendation)*
- 2. Deeper planting will minimize the thin base taper and provide soil anchorage but will come at a cost of shorter sticks, lower plant populations and less initial planting material*
- 3. The conventional planting depth at a narrower spacing of 33cm (25000 plants/ha) performed the best but had taller and thinner sticks compared to the other NovaCane® treatments (may be more lodging prone?)*

For lodging resistance, the deep/hilled up treatments had less stalk diameter taper, better soil anchorage but shorter and lower populations resulting in less planting material available for propagation (80%) of the conventional NC plantlet 'shallow' planting method



SASRI NovaCane[®] observation trial

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Harvested in October 2023



Replicated trial:
NC Setts vs NC
plantlets (from
different trays)



12 PLOTS
PLANTED IN
OCTOBER
2023

October 2023



October 2023

- *Alternating treatments (NC plantlets @ 33cm spacing vs NC stalks)*
- *6 replicates of each (checkerboard pattern), alternating tray types*
- *3 subsequent light watering events over next 2 weeks*



Project team members:

Rowan Stranack; Sharon McFarlane; Sandy Snyman; Aimee Koch; Linda Mkhize
*Philani Malunga (and team) - tending to plantlets and hardening off in glasshouse and planting operations

Extension Specialists:

Project and questionnaire feedback etc.

SASRI Mount Edgecombe: Allan Buss, Lungelo Madiya

Field selection, preparation, husbandry operations, oversight etc...

Research Support Team:

Field planting, ridging up, field measurements etc.

THANK YOU