TwinN in cotton

BUILD STRONGER CROPS
INCREASE YIELDS
DECREASE INPUT COSTS

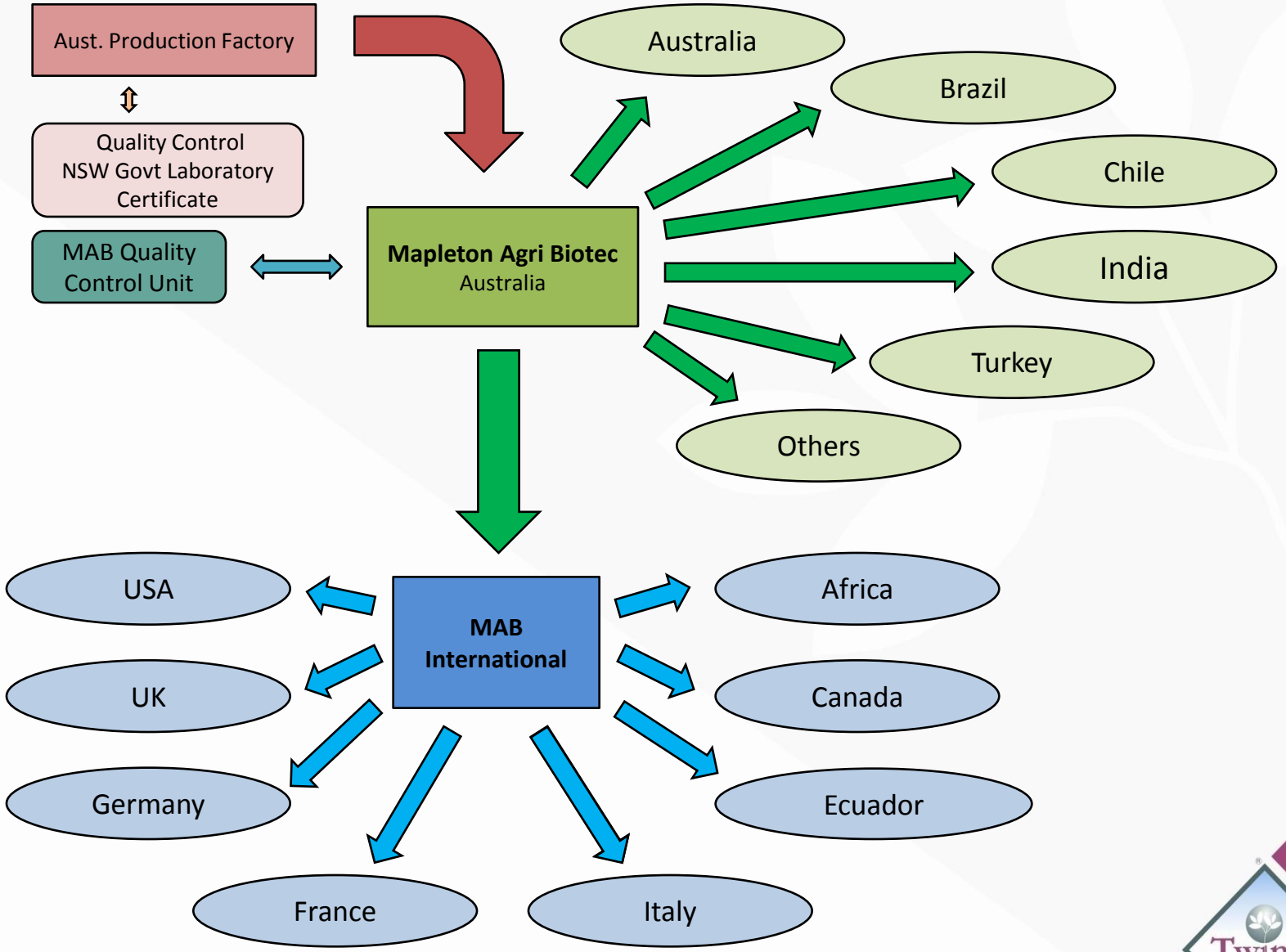
Mapleton Agri Biotec Pty Ltd

TwinN®
YIELD INCREASING MICROBES

What is TwinN?

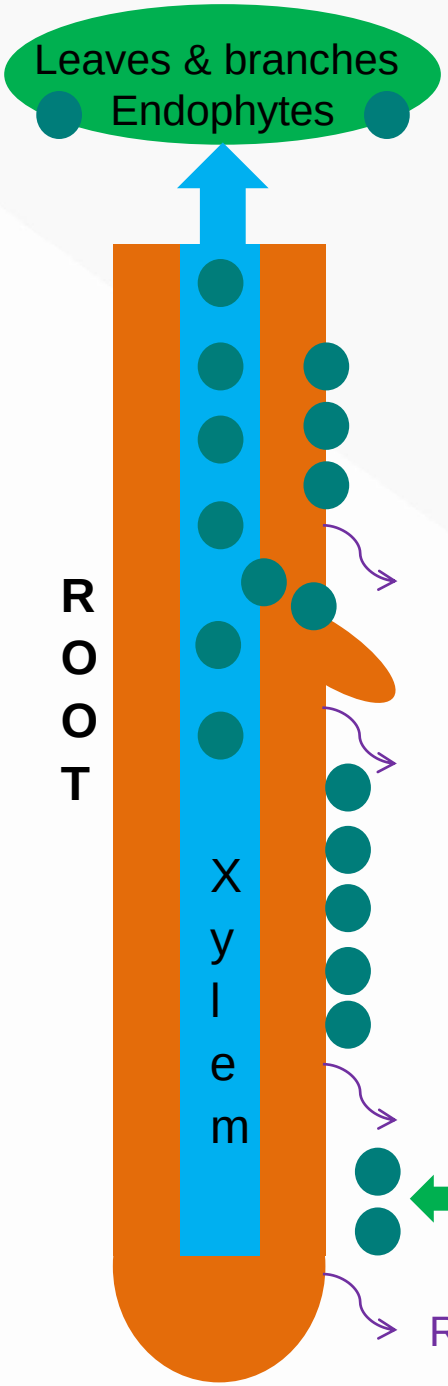
TwinN is a unique product that reduces the amount of N fertiliser needed and increases yields

- Freeze-dried microbial product – selected high performance *Diazotroph* species
  - Produced in modern, sterile fermentation facility
  - Every batch quality control tested by Australian Govt. labs (AIRG)
  - > 10^{11} cfu/ha - very high concentration of microbes
  - Reliable shelf life 12 mo – cool (4^{o}C) storage
  - 1, 5, 10, 100 ha packs



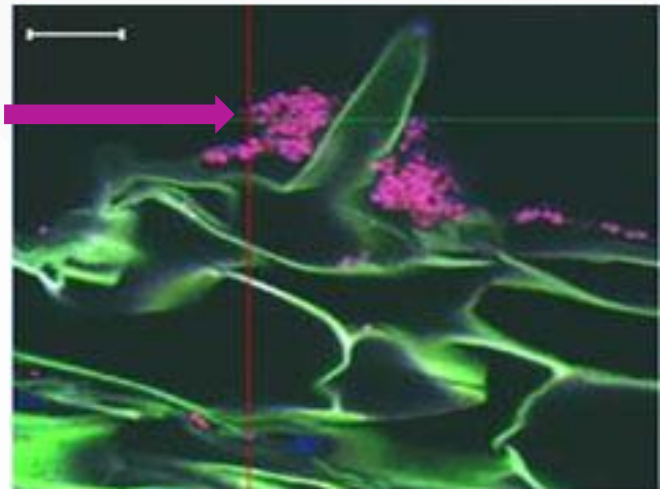
Schematic of supply and distribution of TwinN

Where do the TwinN microbes act after application?



- When applied via soil application they colonise the rhizosphere – the zone of soil very close to roots. They also move up into the plant tissues and end up throughout the plant.
- TwinN microbes get carbohydrates and nutrients as root exudates and from plant tissues. In return they provide N, increase root efficiency and root/soil health – a true symbiosis

Azospirillum sp on rice roots



How does TwinN work?

TwinN improves crop performance by three main mechanisms

1. TwinN microbes convert N_2 from the air into a **steady supply of plant available N (NH_3)** through the entire crop season

2. TwinN produces **larger, more efficient root system** due to production of Plant Growth Factors (PGFs) gives improved capture of applied N fertilisers (= **improved N use efficiency**)

3. **Improved soil health and structure.** Longer term use of TwinN **lowers soil disease pressure** and **builds soil carbon. TwinN microbes assist in mobilising bound P**

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TwinN
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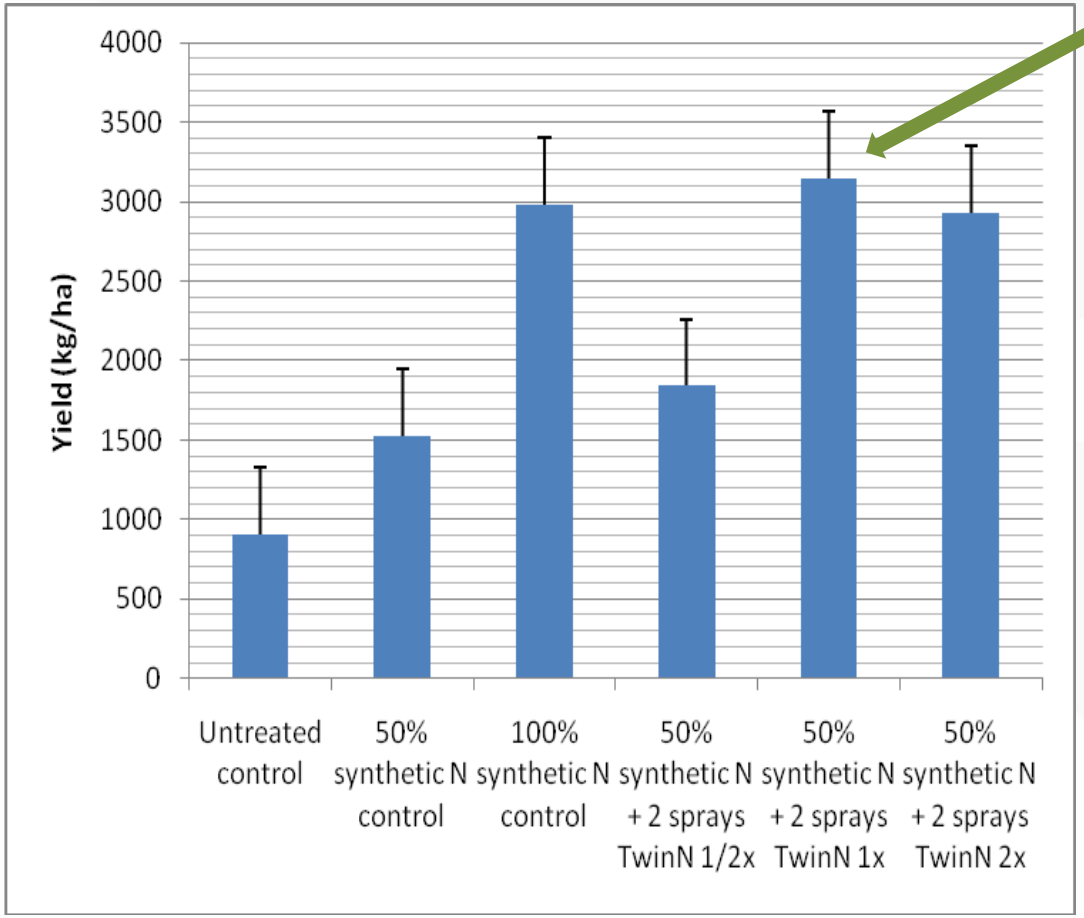
1st Mechanism of Action – N fixation

Wheat – South Africa – 2010 – Independent Registration Trial



- Full rate TwinN with 50% N gave the highest yield and was statistically equal to 100% N.
- 50% N with no TwinN delivered significantly lower yield (50% of control).
- 2X rate TwinN performed no better than 1X
- Half rate TwinN did not perform and is not recommended at all.

This independent trial is an example of TwinN replacing 50% (56 kgN/ha) in a wheat crop with no loss of yield. The control (50%N alone) gave a big yield decline with no TwinN.

2nd Mechanism of Action – larger, more effective roots

TwinN produces **larger root systems** due to auxin synthesis (IAA etc)

Note this picture is from a DPI-measured comparison and root mass rating increased >13% in TwinN plots.

This effect is mainly from increased root hairs increasing the root ball

- Greatly **increased root hair density** gives better nutrient capture of all nutrients
- **Improved capture** of mineralised and applied N **increases nitrogen use efficiency**
- More vigorous root growth **helps crops fight back from root damage** from pests and diseases

Improved N nutrition is due to a combination of N fixation plus better N use efficiency via the effect of TwinN on roots

3rd Mechanism of Action – Improved Soil Health

TwinN can reduce populations of some pathogenic microbes

- TwinN encourages growth of beneficial microbes that help keep soil pathogens in check
- See trial data on www.mabiotec.com for effects of reduced *Phytophthora* and *Fusarium*

TwinN increases root nodulation in legumes

See USDA soybean trial results next slide and clover pictures this slide

TwinN enables reduced N application rates

- Lowers impact of urea on soil organic carbon
- Avoids problems with soil pH
- Lowers impact of synthetic N on soil structure

TwinN increases nutrient availability

TwinN microbes release organic acids **improving availability of P (P solubilisation)** and increase the **availability of some micronutrients** in soils

Picture 9: Clover nodulation on 12 September 2009 (four months after application of TwinN and nine months after trace elements)

Picture 8: Original clover nodulation, 11 December 2009

Soybean – Boone 2007 – US Dept Ag, Illinois

YIELD EFFECTS		
Treatment	**Kg/Ha**	**% increase**
No TwinN or Roundup	3,880 (a)	0
+ Roundup	4,270 (b)	10
+ TwinN + Roundup	4,600 (c)	18.6

- 8.6% increase in yield
- Decreased *Fusarium*
- Increase root pseudomonads (beneficial microbes)
- Increased nodule weight
- Trial repeated at second site and at 2 sites in 2008

SOIL HEALTH EFFECTS			
Treatment	**Fusarium root colonisation**	**Root pseudomonads**	**Nodule weight**
No herbicide	67.5 (a)	116.9(a)	828 (ab)
+ Roundup	106.4 (b)	28.2 (b)	745 (a)
+ TwinN + Roundup	64.0 (a)	80.0 (a)	866 (b) (16%inc)

How to apply TwinN to cotton

- Apply standard pre-plant and early N fertiliser rates
- Reduce later applications of N fertiliser to give a total of up to 20% N reduction (up to a maximum of 40 U of N less)
- OR for systems where N is applied upfront reduce N by up to 20%
- OR apply TwinN over the top of standard applications of fertiliser (when cotton prices are high)
- Keep P, K etc at standard levels
- Apply TwinN at around the start of squaring (approximately one month post-emergence) Later applications are effective over the top of standard fertiliser programs
  - Apply TwinN by liquid injection in enough water to deliver the microbes into the moist part of the root zone, under knife point (disc blade)
  - OR – apply TwinN by overhead irrigation to water TwinN into the root zone
  - OR - apply via flood irrigation water if you are set up to apply nitrogen fertiliser via flood irrigation
  - Do not mix TwinN with agrochemicals in application water

Application must deliver the microbes into a moist root zone

for them to thrive

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TwinN

YIELD INCREASING MICROBES

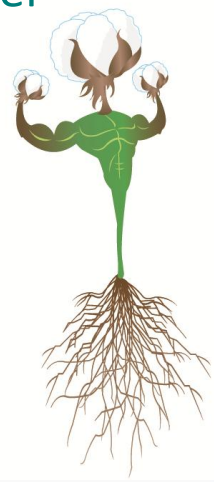
Why use TwinN?

1. Improve profitability

a) Increase yields (when cotton prices are high)

b) Decrease input costs from nitrogen fertiliser (when N prices are high and cotton prices are lower)

Farmers can select between a) and b) according to crop prices and fertiliser prices. When cotton prices are high use a small, or zero reduction in N to maximise yields. When cotton prices are low use a 20% N reduction to assist in maintaining profitability.



2. Increase sustainability of production

a. Improve soil productivity and crop vigour

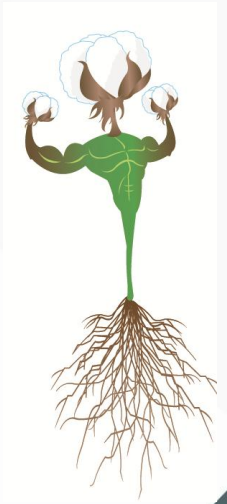
b. Decrease synthetic nitrogen effects on the environment

c. Increase soil microflora. TwinN injects large numbers of N fixing and growth stimulating microbes into the soil each season. TwinN also encourages other beneficial microbes that are ideally present at high levels to assist root and soil health.

On-Farm Demonstration in Irrigated Cotton
Hillston, NSW, 2010-11

Key Results – Yield ⬆ & Input costs ⬇ - Profit

- With a reduction of 47 units N/ha, the TwinN treated rows outperformed the standard practice rows by a full 0.75 bale per hectare
- When the price of urea was $540/t landed on farm the grower reduced costs by $30/ha. Urea prices are higher now.
- The added yield was worth $375/ha @ $500/bale. Cotton prices are lower now.
- Quality measurements showed a small improvement in micronaire in TwinN bales. This moved the grower away from the discount cut-off for low micronaire (<3.5).

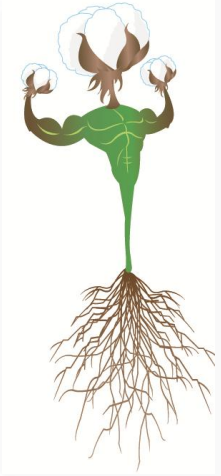


TwinN
YIELD INCREASING MICROBES

Cotton at Hillston, NSW, 2010-11 cont'd

Treatment	Total synthetic N units/ha	Yield average per hectare (Bales)	Yield increase compared to standard
Standard Practice	190	10.91	0
TwinN + 75%N	143	11.66	6.9%

- TwinN applied under knife point into root zone
- 9 reps/treatment over total of 23 ha field
- cv 71 BRF.



MAB thanks Rick Storrier for supplying this data

TwinN
YIELD INCREASING MICROBES

TwinN on-farm demonstration, Cotton, Kilmarnock Farming Pty Ltd, Boggabri NSW. 2011-12 season.

TwinN was applied as part of a series of products tested by Andrew Watson (current Chair of Cotton Australia). The spray application was made late Dec 2011, 2 weeks after first flower, using 200L water/ha at dusk and immediately watered in via flood irrigation. This was to simulate a centre pivot application. The soil treatment was made into the slot at planting. All treatments were on top of the standard program (170kg N, 50 kg DAP, 60kg KCl, 50l Zinc Sol. All applied pre-plant.)

Comments from Andrew Watson:

- Firstly, these results highlight the deficiencies of block trials. While all treatments yielded above the control, the control was probably in the worst part of the field.
- However, I think the distinct line between the Control and the TwinN Spray Applied treatment is significant. The red patch essentially stops at the boundary, and this was visually apparent (crop colour) through the season.
- While the Flowphos yielded highest, it was probably in the best part of the trial.

Summary of results

- TwinN, applied via boomspray and watered in, produced a visual response compared to the adjoining control strip. MAB recommends an earlier application of TwinN (ideally at start of squaring).
- The yield map showed the usual variation across the paddock that makes block trials difficult but the clear boundary where TwinN was applied indicates that the measured yield difference **(+ 0.46 bales, 6%)** was real.
- TwinN applied at seeding was not considered effective (despite high yields) since it appeared that the natural yield variation patterns across the field were not affected by the treatment. Since cotton seed is coated in anti-microbials this application strategy is not recommended.

MAB would like to thank Andrew Watson for providing this data

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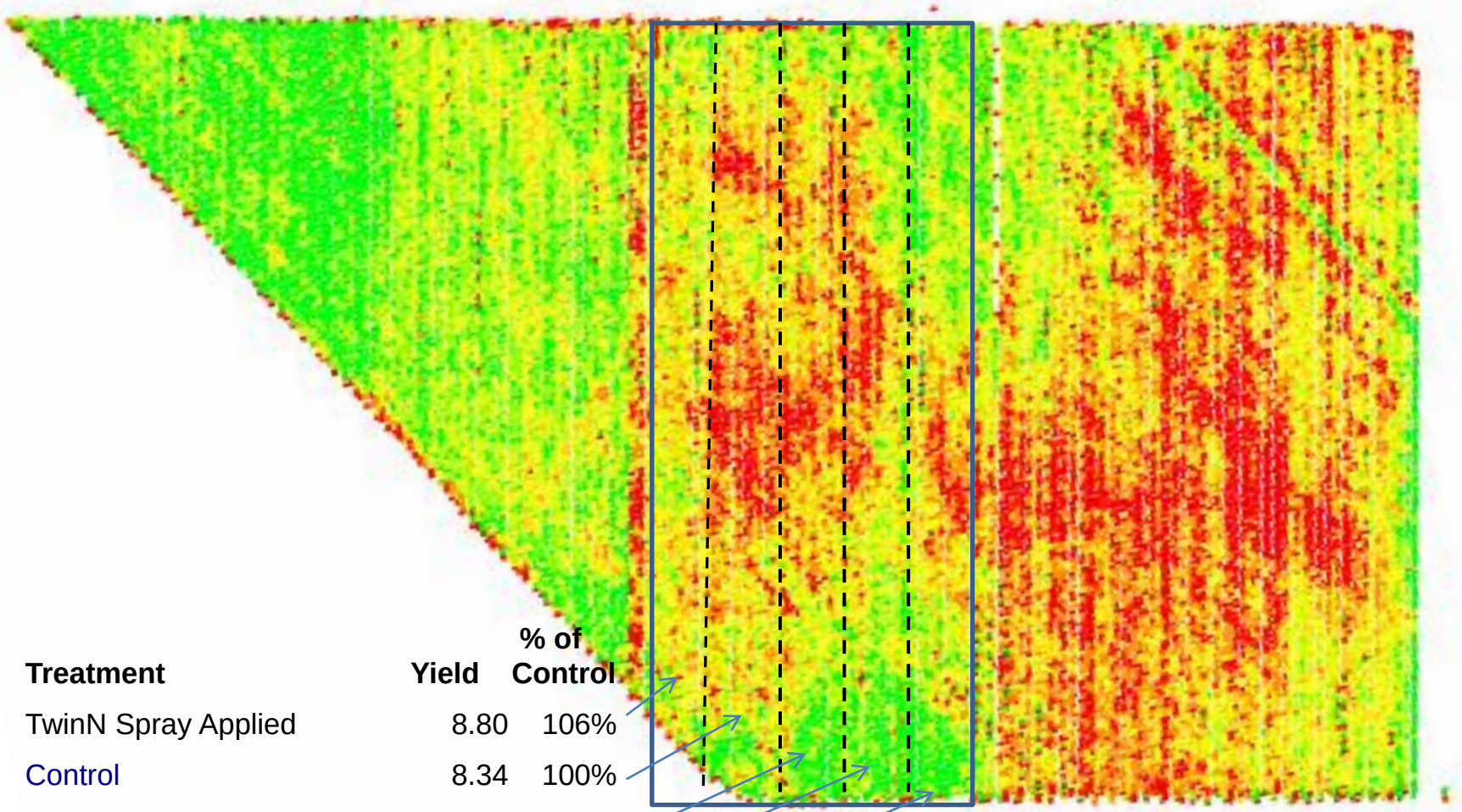


Treatment	Yield	% of Control
TwinN Spray Applied	8.80	106%
Control	8.34	100%
Other product	8.74	105%
TwinN Soil Applied in slot	9.02	108%
Flowphos in slot	9.27	111%

TwinN water run application trials
Cotton - Darling Downs, Qld, 2012

- Pursehouse Rural conducted an independent trial to assess the performance of TwinN applied by water run irrigation
- The trial compared yield, leaf nitrogen levels and soil nitrate levels after the harvest
- TwinN was compared to two synthetic fertiliser programs that provided an additional 80 U/ha of N more than the TwinN plus reduced N fertiliser program

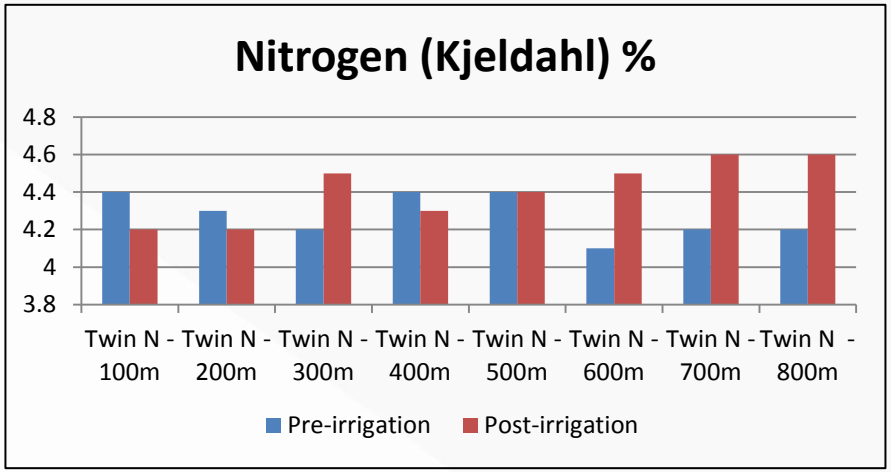
USE OF TwinN PRODUCED EQUAL YIELDS DESPITE AN 80 U/HA N REDUCTION

Note: This is a significantly larger reduction than MAB recommends

Yields of TwinN versus two standard N plots (which gave ~equal yields)	
TwinN plus 160 kgN/ha	Conventional 240 kgN/ha
7.1 T/ha	7.1 T/ha

- TwinN was diluted into 1000L of water and delivered by a float valve flow controller into irrigation flow up the 800m furrow
- All rows received the same pre-plant application of 160 U N/ha
- Leaf samples were taken at 2.5 months post-planting and again at 30 days after application of TwinN

- TwinN was applied at one flower per metre crop stage (17 Jan 2012) while comparison rows received an additional 80 U of N/ha at the same time
- Soil samples were taken after harvest to measure nitrate levels remaining in TwinN versus non-TwinN rows
- Yields and soil N levels were averaged for the two N fertiliser products for this comparison

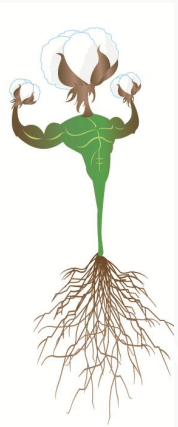


	TwinN	Standard
Soil Depth	Nitrate N (kg/ha)	
0 – 10 cm	10	11
10 – 30 cm	10	11
30 – 60 cm	13	13
Weighted N	88	91

Leaf N levels showed the TwinN microbes were effectively distributed down an 800m row by water run application. Post-irrigation levels were measured one month after TwinN was applied.

Average pre-application leaf N was 4.28% and post-application was 4.41%

Soil N levels were equivalent in TwinN and standard rows after the crop was harvested showing TwinN use did not deplete soil N reserves to meet the N shortfall of 80 U N/ha



CONCLUSIONS

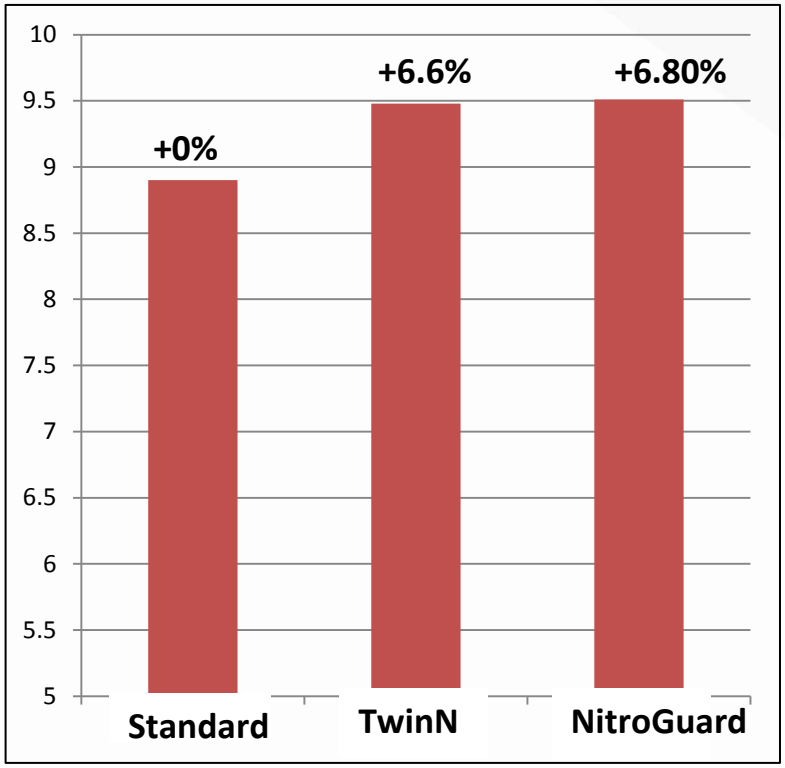
- **Application of TwinN with a reduction of 80 U of N produced the same yield as two different full nitrogen fertiliser programs. A smaller reduction in N can be used to target increased yields**
- **Yield and leaf nitrogen levels showed that TwinN was able to be delivered effectively to the end of an 800 m row by water run application**
- **Soil analysis after harvest showed no differences between the TwinN and the full nitrogen programs, confirming that TwinN and reduced N fertiliser rate treatment did not maintain full yields by additional depletion of soil N reserves**

TwinN in commercial use near Adana, Turkey. Harvested 7.4 bales/ha

TwinN liquid inject trial in cotton ‘Riverstone’, Narrabri, NSW, 2012-13

Summary of trial

- A replicated trial in cotton compared plots treated with TwinN or NitroGuard plus standard fertiliser rates **versus** the standard farm fertiliser program.
- **Yields** were 8.90 bales/ha for the standard farm program, 9.48 bales/ha (+6.6% yield increase) for TwinN and 9.51 bales/ha (+6.8%yield increase) for NitroGuard.
- **Returns per hectare** for an extra 0.6 bales/ha at $440/bale (minus costs of TwinN or NitroGuard) were improved by **$240/ha** by use of either TwinN or NitroGuard.



TwinN and NitroGuard Trial

Conducted by Kalyx Australia Pty Ltd

Site: ‘Riverstone’, Narrabri

Standard: 200kgN/ha

TwinN: 200 kgN/ha plus TwinN 14/12/12 at early-mid-squaring (15 nodes) via liquid inject tines into roots (150L/ha).

NitroGuard: as per TwinN

RESULT

Additional 0.6 bales/ha for both TwinN and NitroGuard over the farmer Standard

TwinN liquid inject trial in cotton
'Riverstone', Narrabri, NSW, 2012-13

Treatments

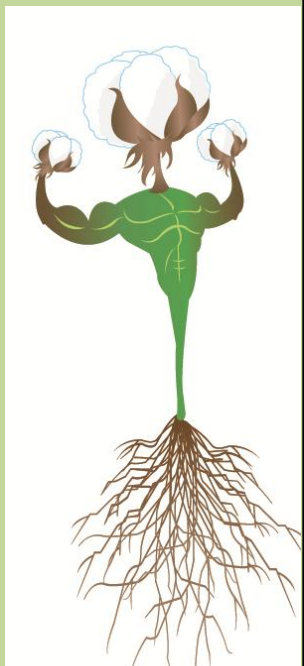
1. **Standard** – standard farm fertiliser program including 200 kgN/ha
2. **TwinN** – standard farm program plus TwinN at early – mid-squaring
3. **NitroGuard** - standard farm program plus NitroGuard at early – mid-squaring

NitroGuard is a new MAB product which supplies TwinN microbes plus additional microbe species. For further details contact MAB.

Trial details

At "Riverstone" near Narrabri NSW

- Six reps per treatment
- Cv. Sicot 74 BRF
- TwinN and NitroGuard applied by liquid inject tine at 155 L/ha using 30 psi into moist soil
- Application was 4/12/2012 at early to mid-squaring

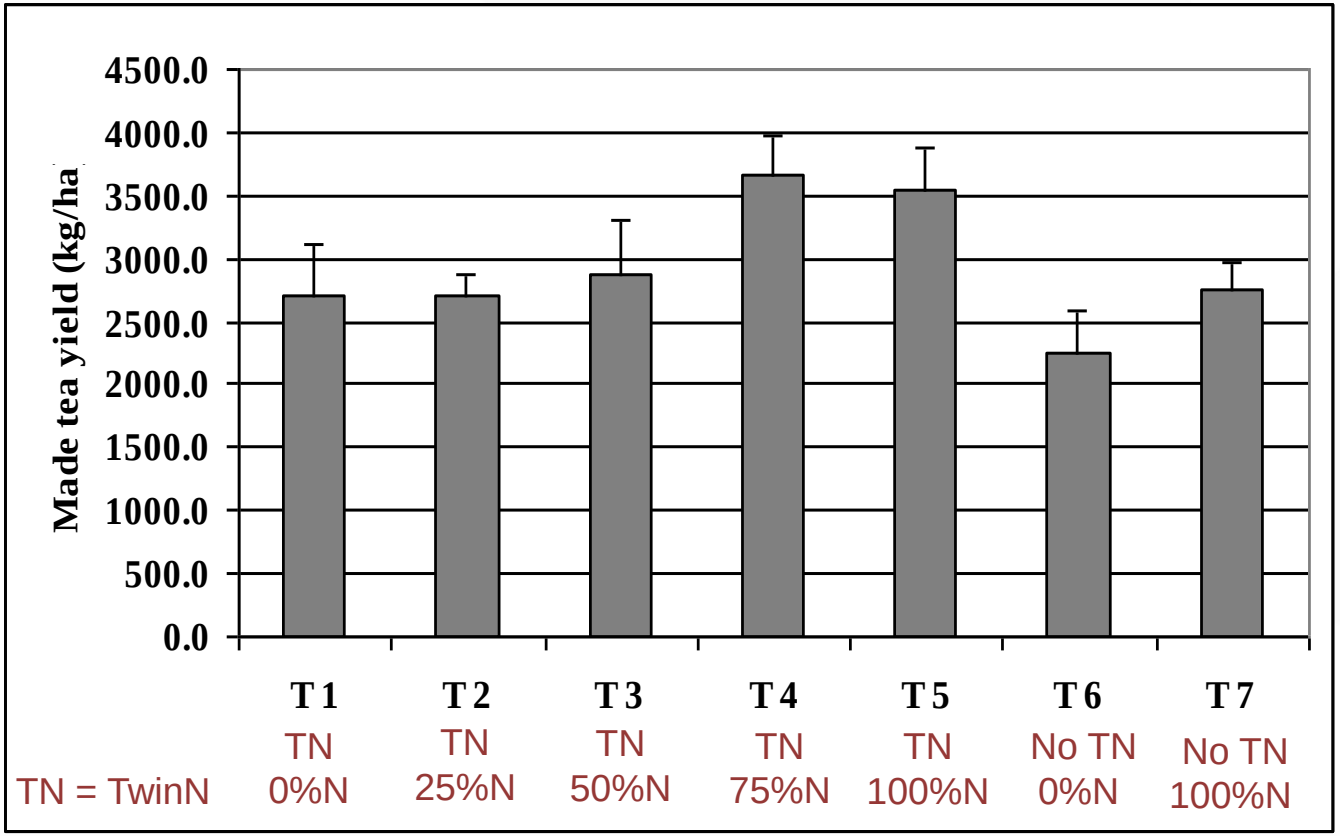


OTHER CROPS - Independent avocado and tea trials

Westfalia Technological Services, Avocados, South Africa, June 2012

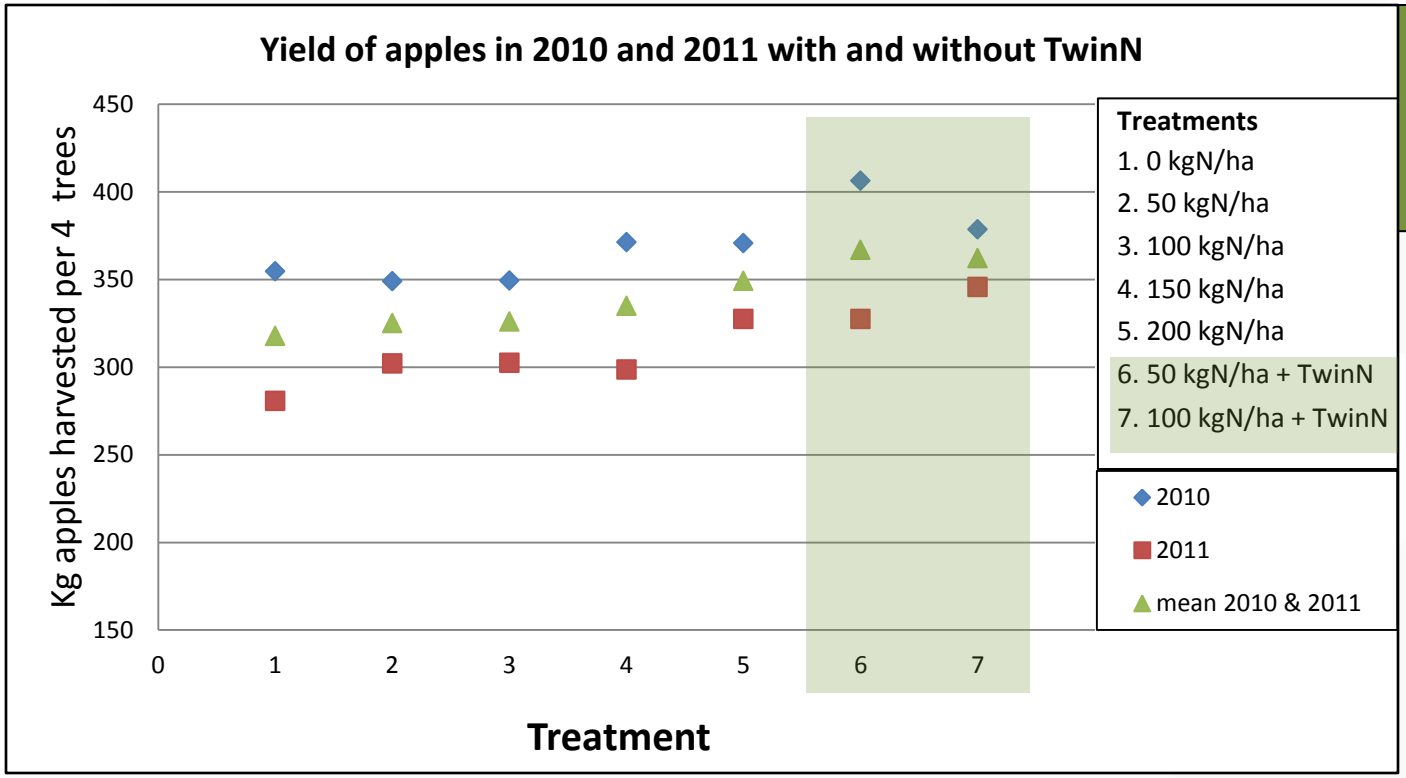
Summary

As expected, there are no appreciable differences in tree health or yield between the trees treated with Carbotech® and/or TwinN® and the control. It is too early in the trial to expect any differences – if any differences are to appear. The concentration of Nitrogen in the trees treated with Carbotech and/or TwinN showed a 25-28% increase in the first season after a 25% N reduction. While these results are promising Westfalia cannot endorse the products without further results.



Yield from the second year of a trial in tea by TRFCA in Malawi. Results from a second site were similar. Standard 100%N was 275 kgN/ha. Because tea is a high value crop these yield increases were very profitable.

OTHER CROPS - Bulmer Cider, Independent replicated trial, Apples, UK, 2010 & 2011



TwinN was applied to soil via two applications per year in spring and late summer

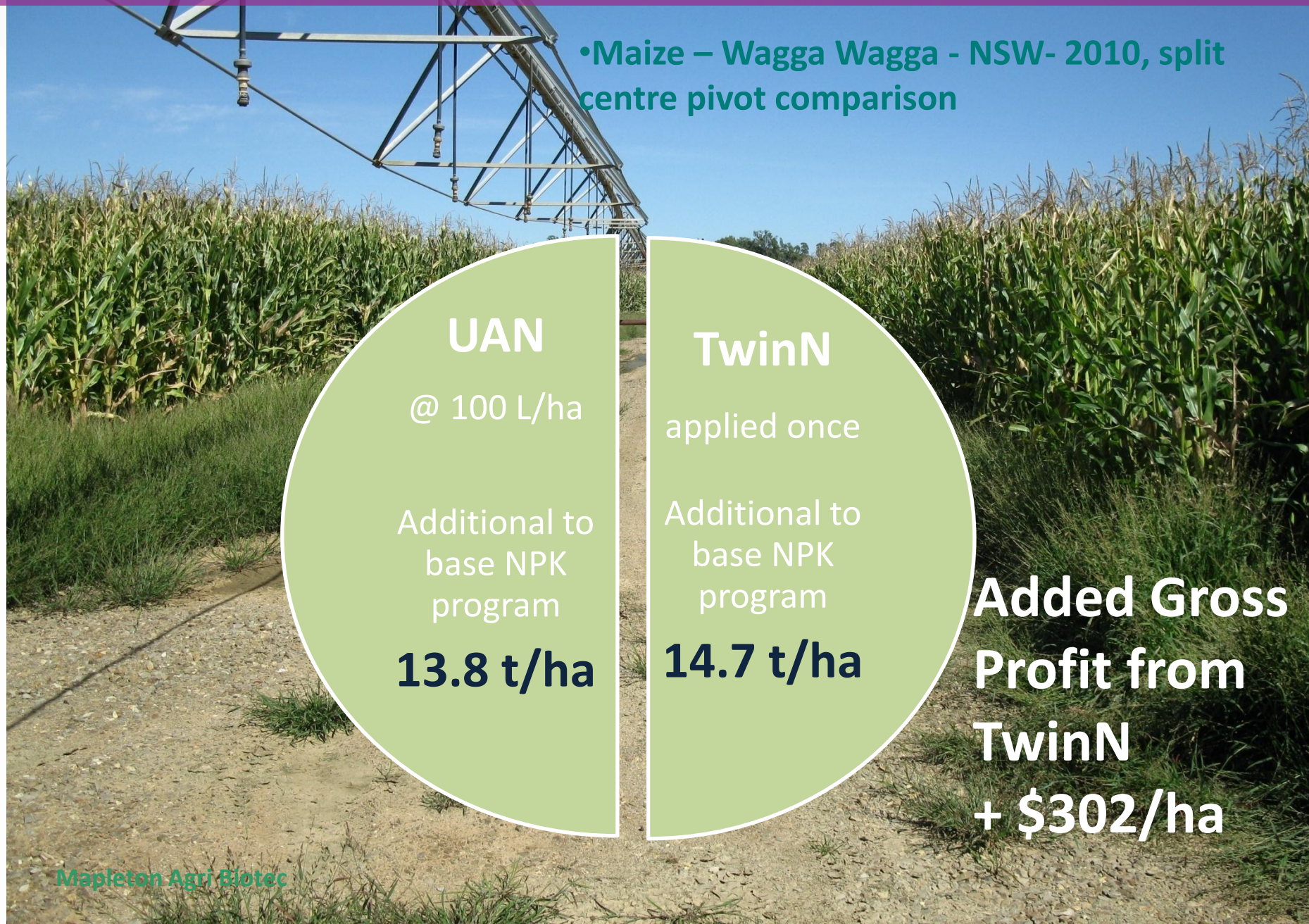
This trial was conducted to test TwinN's capacity to increase profits via improved yields and reduced fertiliser costs.

Improved sustainability of production was also noted.

Conclusions

- TwinN plus 50 or 100 kgN produced the highest yield in 2010 & 2011
- TwinN plus 50 kgN/ gave a 12.6% yield increase over 100 kgN with no TwinN
- This translates to reduced N costs, increased returns, decreased C footprint (see next slide) and improved long term soil health due to reduced N fertiliser applications

OTHER CROPS- Farm Demonstration, Maize



- Maize – Wagga Wagga - NSW- 2010, split centre pivot comparison

UAN

@ 100 L/ha

Additional to base NPK program

13.8 t/ha

TwinN

applied once

Additional to base NPK program

14.7 t/ha

Added Gross Profit from TwinN + $302/ha

Mapleton Agri Biotec

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