



# TwinN - Build Stronger Crops



# 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°C) storage
  - 1, 5, 10, 100 ha packs

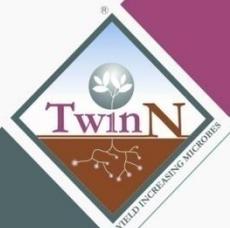


# Who uses TwinN?

- Conventional farmers wanting to reduce N use and increase profits
- Biological farmers wanting a reliable microbial N fixer and soil improver
- Organic farmers wanting improved N nutrition and better crop growth

# Which crops?

- Broadacre/field crops – cereals, corn, cotton, rice
- Sugarcane
- Intensive temperate and tropical pastures/forage/lucerne
- Temperate fruits – apples, stone fruits, blueberries
- Tropical tree fruits, avocado, bananas, citrus, coffee, tea
- Macadamia, pecan, almonds
- Wine and table grapes
- Vegetables
- Others



# How does TwinN work?

## TwinN improves crop performance by three main mechanisms

1. Converts  $N_2$  from the air into a **steady supply of plant available N** through the entire crop season
2. 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**

## How to apply TwinN?

TwinN is applied to the roots where the microbes colonise, multiply and move all through the plant

Common application methods include:

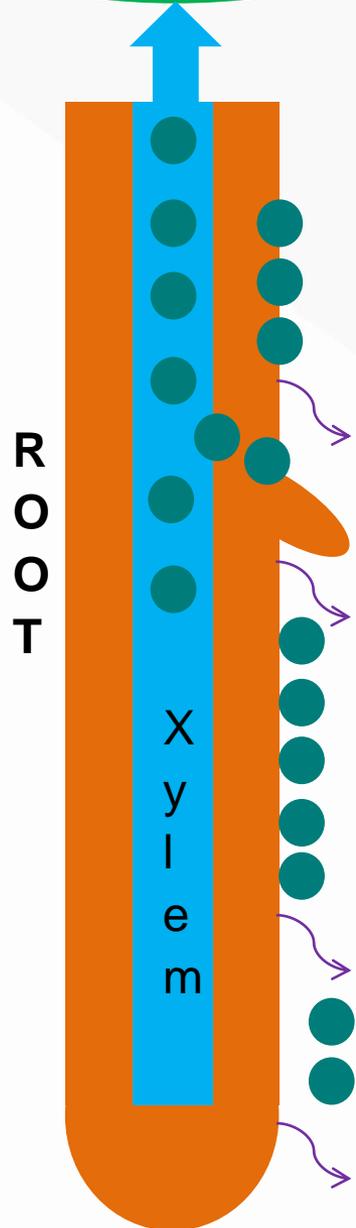
- Drip, micro sprinklers or overhead irrigation systems – very convenient
- Trickle tape for vegetable crops
- Knifing into the root zone as for liquid fertilisers - common in cotton and sugarcane
- Spraying onto moist soil under trees – use a streaming nozzle and apply easily down the rows
- Delivery by flood irrigation for farmers who are set up to deliver urea by that method
- Boomspray onto wet soil or pasture

**Application must deliver the microbes into a moist root zone for them to thrive**



# Where do the TwinN microbes act after application?

Leaves & branches  
Endophytes

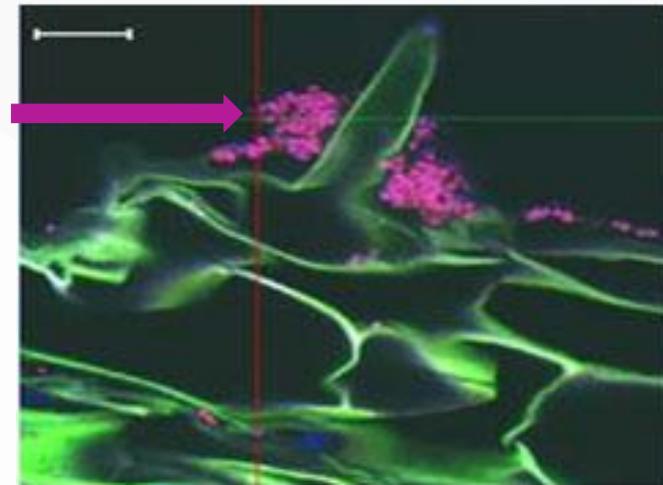


- When applied via soil application they colonise the rhizosphere – the zone of soil very close to roots. They also move up into the plant tissues and end up throughout the plant.
- TwinN microbes get carbohydrates and nutrients as **root exudates** and from plant tissues. In return they provide N, increase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

Azospirillum sp  
on rice roots

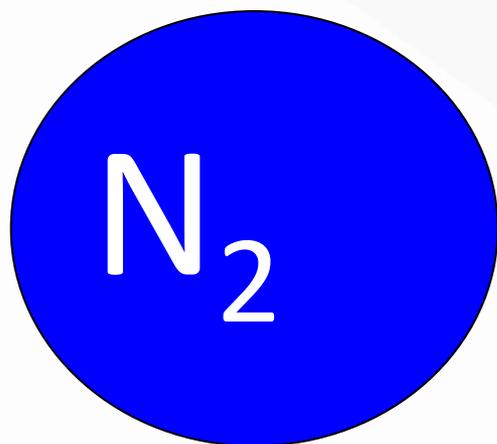
TwinN microbes colonise roots

Root exudates

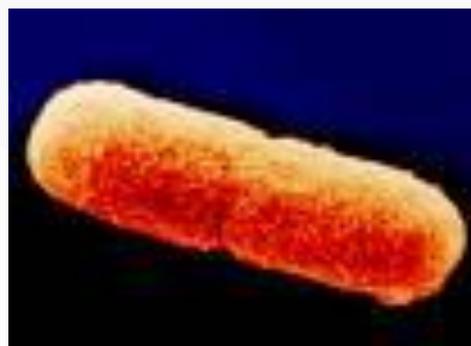


# 1<sup>st</sup> Mechanism of Action – N fixation

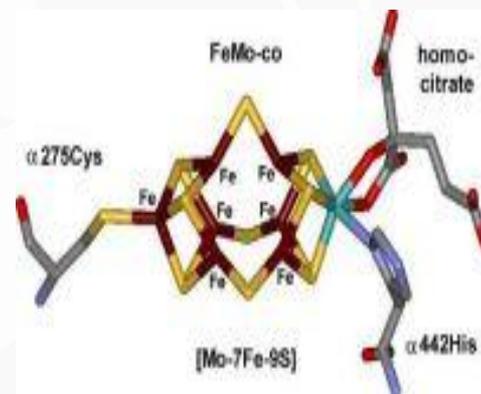
- **NH<sub>3</sub>** is supplied steadily right through the season
- This helps keep Total Leaf N at optimum levels without high nitrates which reduce fruit quality and shelflife



From the atmosphere



N Fixing Bacteria

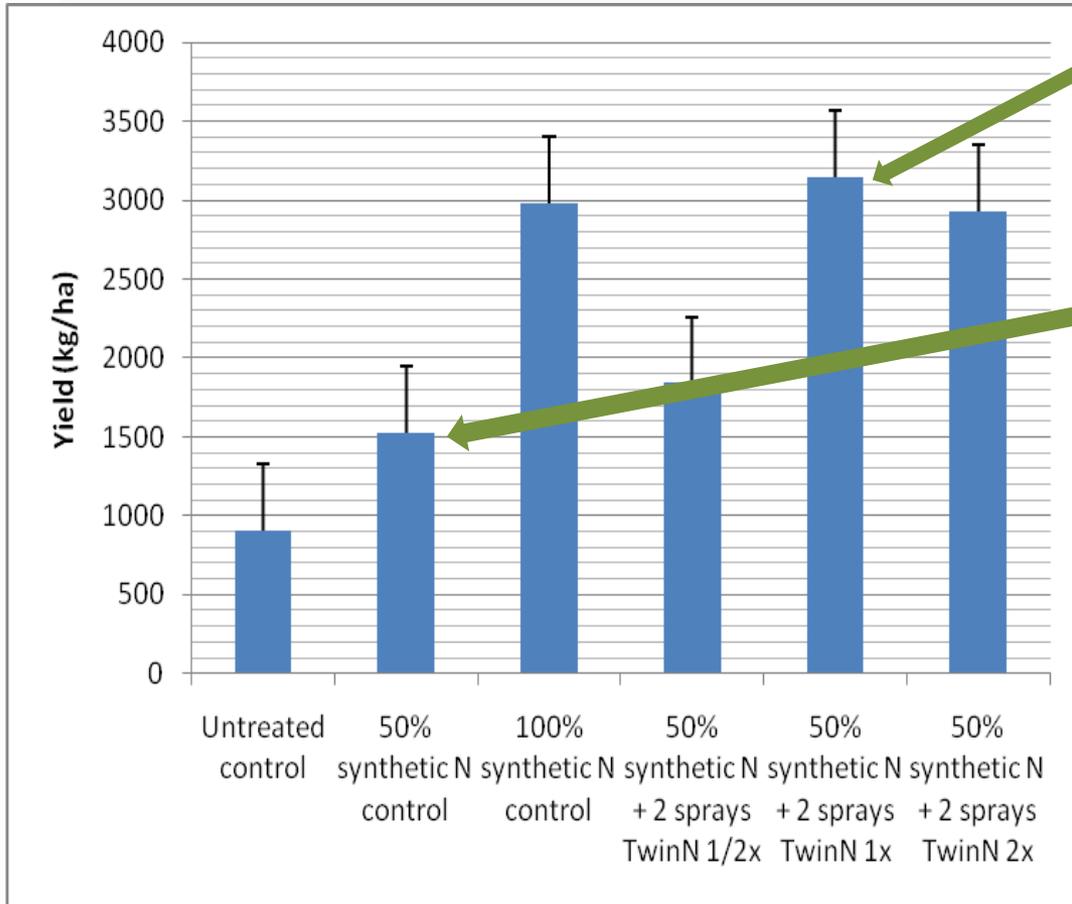


Nitrogenase enzyme



# 1<sup>st</sup> 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.

For most cereals we recommend a single TwinN and a 25 - 35% reduction in synthetic N, depending on N prices and value of the crop yield each season. TwinN gives farmers flexibility to adjust input costs and yield targets for each season.

## 2<sup>nd</sup> 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**



# 3<sup>rd</sup> 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](http://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

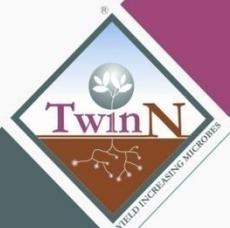
## YIELD EFFECTS

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)



# Why use TwinN?

## 1. Improve profitability

- a) Decrease input costs from nitrogen fertiliser (when N prices are high and crop prices are low)
- b) Increase yields (when crop values are high)

Farmers can select between a) and b) according to crop prices and fertiliser prices. For high value/ high yield crops apply TwinN on top of the standard program or use a small N reduction.

## 2. Increase sustainability of production

- a) Improve soil productivity and crop vigour
- b) Decrease synthetic nitrogen effects on the environment
- c) Decrease carbon footprint of production (eg bio-ethanol)

## 3. Enable compliance with various legislations to limit nitrogen fertiliser applications – without the normal yield penalties from reduced N applications



# Farm Demonstration

•Maize – Wagga Wagga - NSW- 2010

**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**

# Trial Results - sugarcane

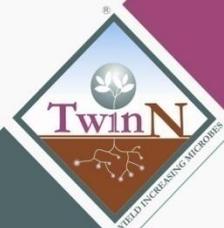
- Sugar – Maryborough – QLD - Australia - BSES trial – 2008-09

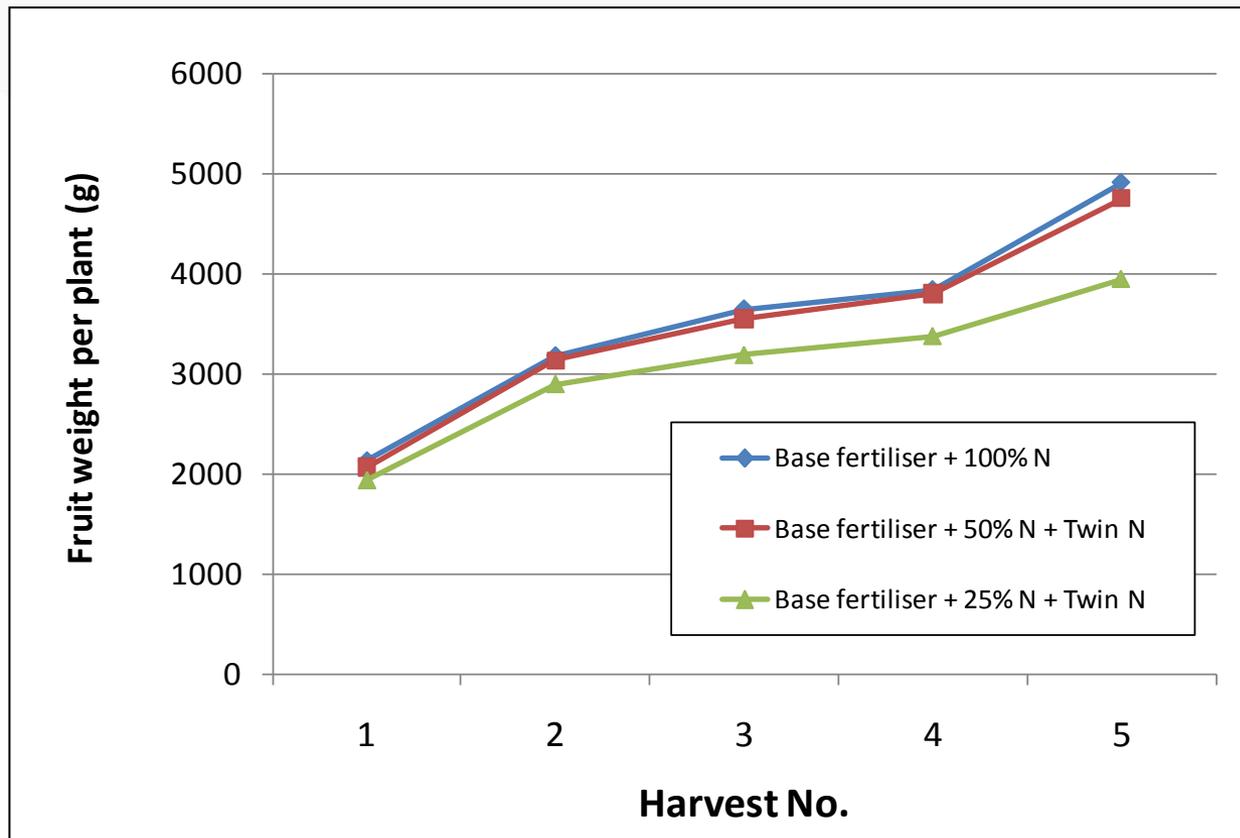
Cane yield TC/ha		
Treatment	TC/ha	
75N+1TwN	82.0	A
150N	81.9	A
75N+2TwN	73.8	A
33N+2TwN	58.9	B
LSD p0.01=12.8		
Sugar yield TS/ha		
Treatment	TS/ha	
75N+1TwN	13.6	A
150N	13.4	A
75N+2TwN	12.5	A
33N+2TwN	9.9	B
LSD p0.01=2.3		

- TwinN enabled the same yield from 50% N plus TwinN as from the usual 100% N fertiliser program
- After multiple industry trials and commercial use in large Estates in Africa and S America over 3 years we recommend
  - A. 65% N plus 1 TwinN if sugar prices are low
  - B. 75 – 100% N plus 1 TwinN if sugar prices are high



Note – many other sugarcane trial results on website





TwinN was applied twice by trickle irrigation

- TwinN plus 50% N gave the same yield as 100%N (120 kgN)
- **MAB recommends starting with 75% N plus TwinN to target a yield increase**
- Growers like to reduce N late in the crop to guarantee fruit quality is high (Reduced nitrates in fruit improves storage and fruit texture)

# Organic Potato Herefordshire UK - 2008



Tubers by grade and yield

- Increased yield and bigger tubers
- We recommend 2 x TwinN plus organic programs or 2 x TwinN plus 75% N rate





### **TwinN used in organic blueberries in Chile**

On the left, no TwinN and nitrogen deficiency is evident.

On the right, 21 days after TwinN application and healthy leaf colour is regained



### **TwinN used in organic avocado, Australia**

On the left, no TwinN

On the right, 2 months after a soil application of TwinN

Part of a trial by Avocado Australia



### **TwinN used in organic cherry in Chile**

On the left, no TwinN

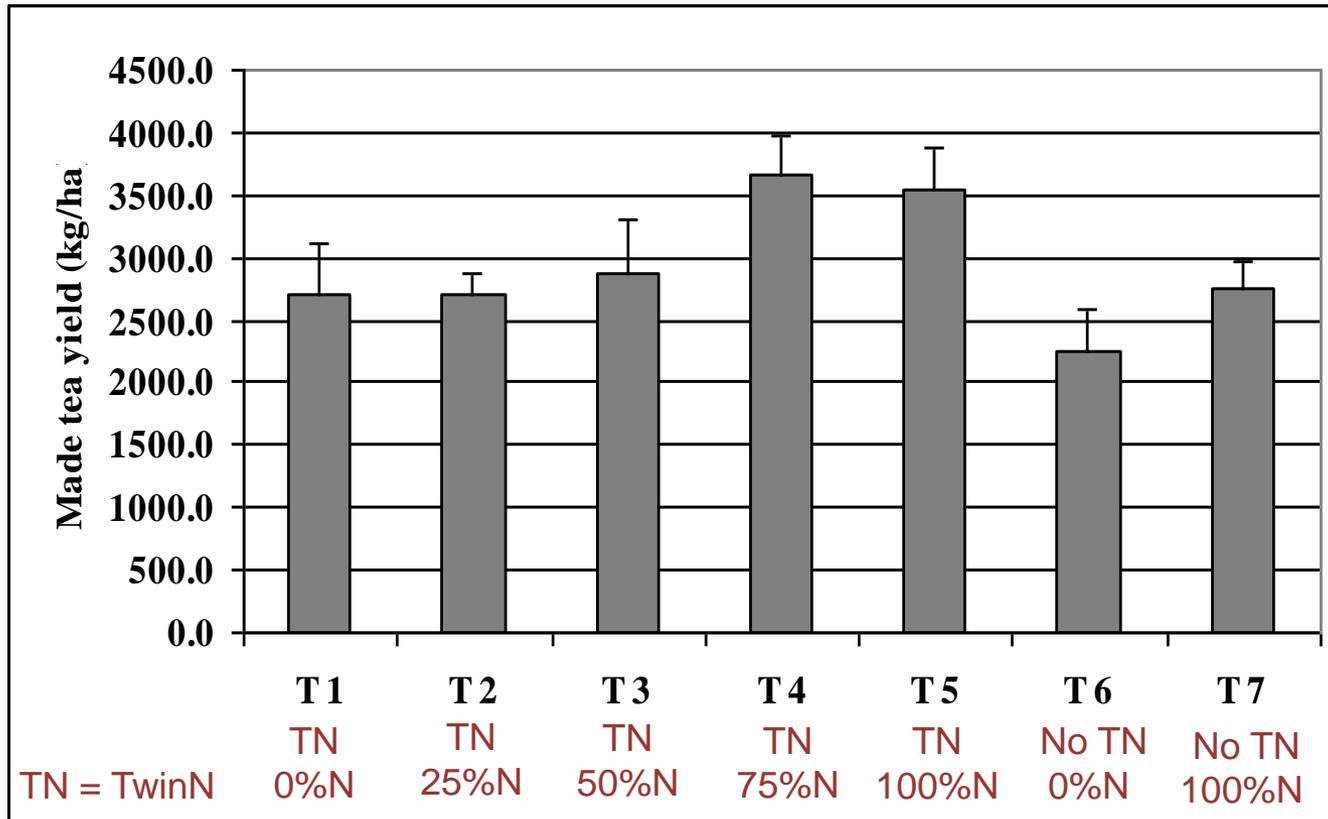
On the right, 120 days after TwinN application via fertigation. Roots showed much greater secondary root development

# 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.

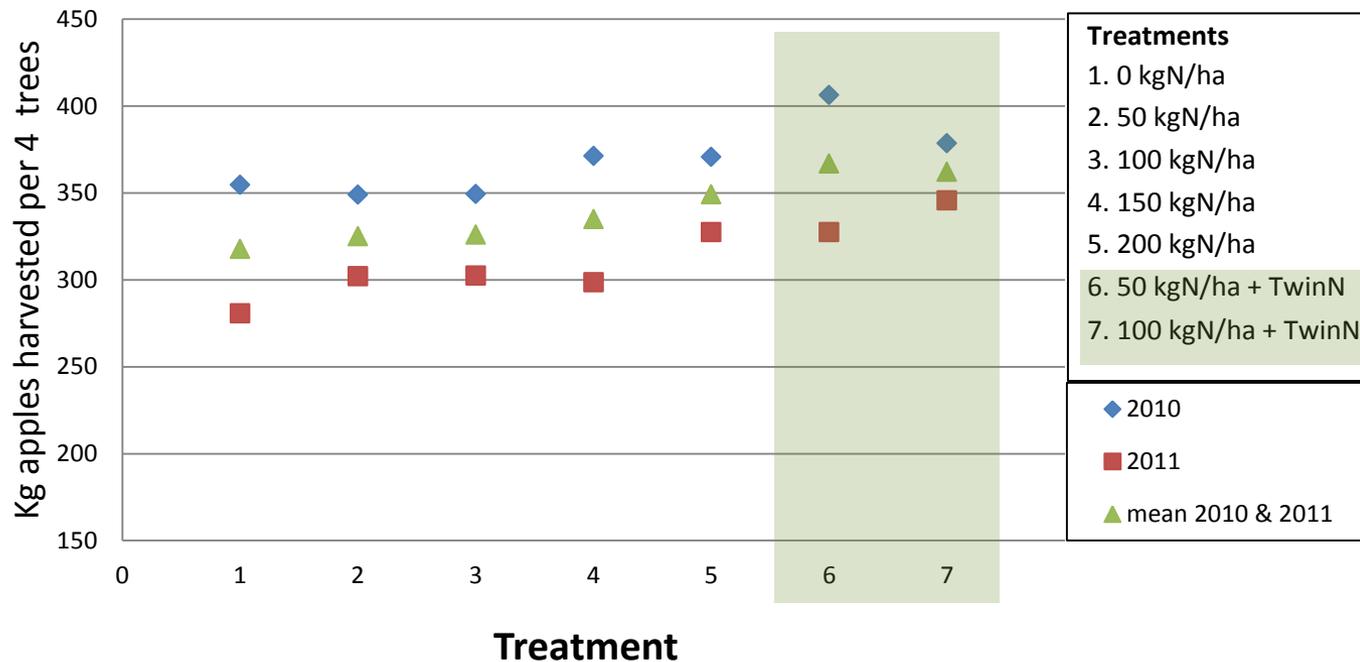


Yield from the second year of a trial in tea by TRFCA in Malawi. Results from a second site were similar. Standard 100%N was 275 kgN/ha. Because tea is a high value crop these yield increases were very profitable.



# Bulmer Cider, Independent replicated trial, Apples, UK, 2010 & 2011

Yield of apples in 2010 and 2011 with and without TwinN



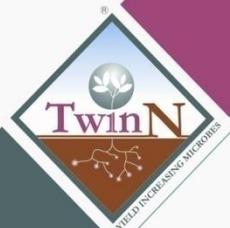
TwinN was applied to soil via two applications per year in spring and late summer

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





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