Amorphous silica

(Plant Available Silicon – PAS)

Friend to farmer & planet.

Every grain, stalk, root a carbon sink. Soil too.

Water and Nutrient-use efficient.

Increase yield and profitability.

Presentation by Peter Prentice | peterp@agripower.com.au

Agripower Australia, producers of Agrisilica® | ICSA 2025 – Belgrade

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1 PHYTOLITHS

Amorphous Silica-rich deposits, which form in plant biomass, encapsulate carbon (**PhytOC**) and sequester it for up to 1,000 years*. Phytoliths have been proposed as a significant carbon sink.

2 WATER (WUE)

The UN reported in 2024 that drought-related costs currently exceed $307 billion annually. Farmers need the ability to reduce irrigation applications without compromising their profitability. Keeping productivity high while being able to use less water is known as Water-Use Efficiency (WUE)

* Tan et al., 2021

Low-cost, fast, highly efficacious, 100 % natural amorphous-sourced Plant-Available Silicon fertiliser is a proven game-changer.

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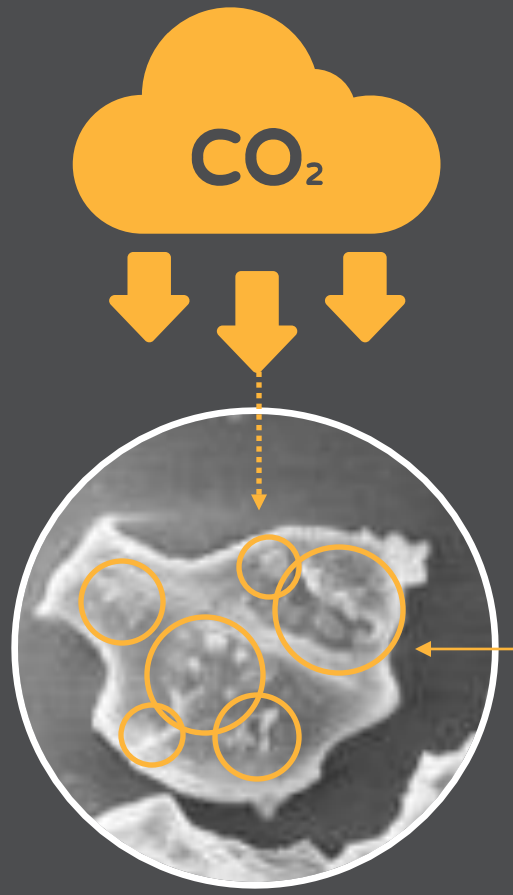
1

PHYTOLITHS

The importance of Plant Available Silicon (PAS)

1 PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)



PAS Phytolith with Sequestered Carbon

PAS – the only nutrient that captures and locks up Carbon for millenium

Phytoliths are microscopic rigid structures composed of amorphous silica, nitrogen and carbon.

Phytoliths increase soil stable carbon.

- As plants litter, decay or are tilled back into the ground, phytoliths persist in the soil.
- Carbon stored in phytoliths is permanent and resistant to breakdown by soil microbes.
- Phytoliths retain their integrity for hundreds, even thousands of years.

1 CO2, PhytOC & Carbon Sequestration via agriculture

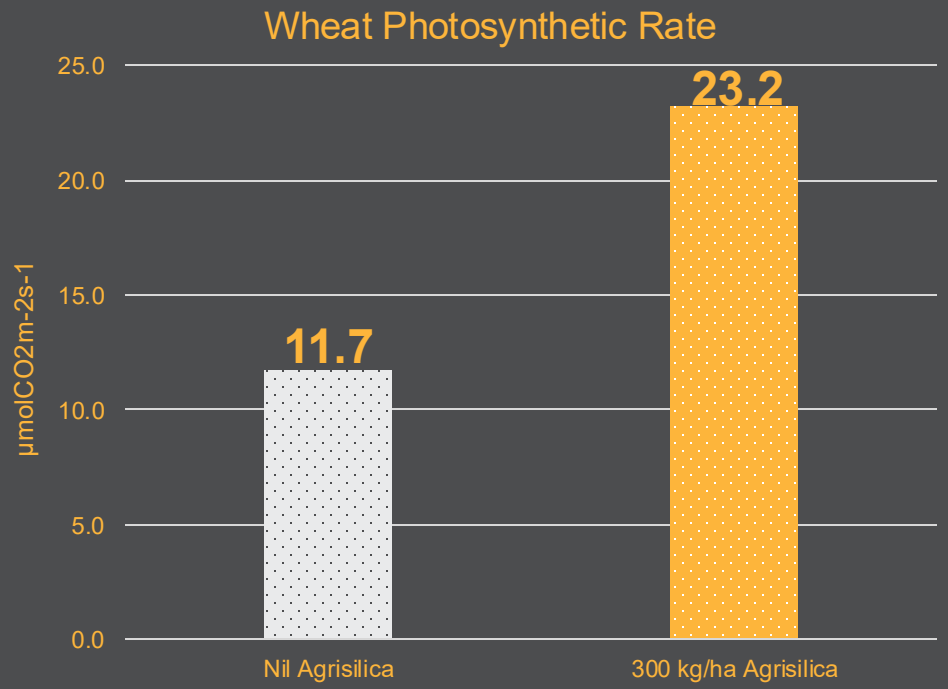
The importance of Plant Available Silicon (**PAS**)

CO_2 is a primary chemical compound for photosynthesis.

By adding Agrisilica®, crops become more erect, capturing more sunlight, which crop converts to more energy. The plant now grows bigger: biomass is increased leading to -

- *Increased intake of CO_2*
- *Increased photosynthesis*
- *Reduced atmospheric CO_2*
- *Increased PhytOC*
- *Increased Carbon sequestration*

98% Photosynthetic Rate-Increase in Wheat using PAS-rich Agrisilica®



HIGH SIGNIFICANCE: Photosynthesis increased by 98% with Agrisilica® compared with Control. The result was significant at P=0.05. Jeer et al (2020)

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1 CO2, PhytOC & Carbon Sequestration via agriculture

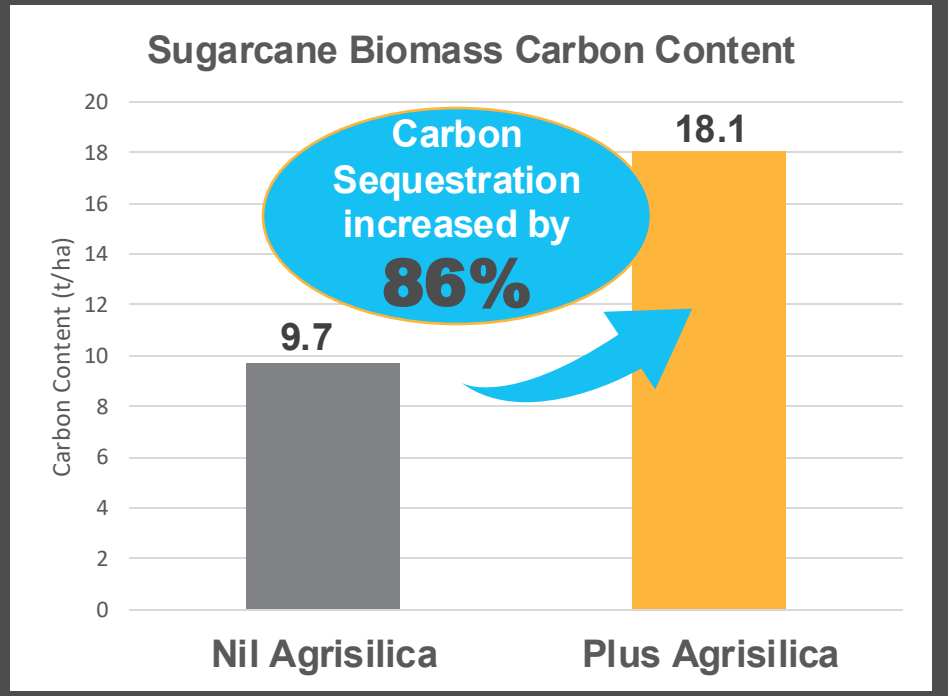
The importance of Plant Available Silicon (**PAS**)

The importance of root system size in relation to carbon sequestration and soil carbon cannot be overstated.

It is estimated that nearly 50% of the carbon fixed by soil-grown plants (via photosynthesis) is distributed to the soil: half of this Carbon is retained as root tissue, and the other half is root exudate.

(Neumann et al, 2000)

Sugarcane Carbon content increased from **9.7 tonnes to 18.1t/ha**
Total yield increased from
72.1t/ha to 133.8 t/ha



Sugarcane | Brazil Aug '22-Oct '23 | *Universidade Federal Rural de at theTrapiche Sugar Mill, Pernambuco, NE Brazil with Trapiche Sugar Mill agronomists.*

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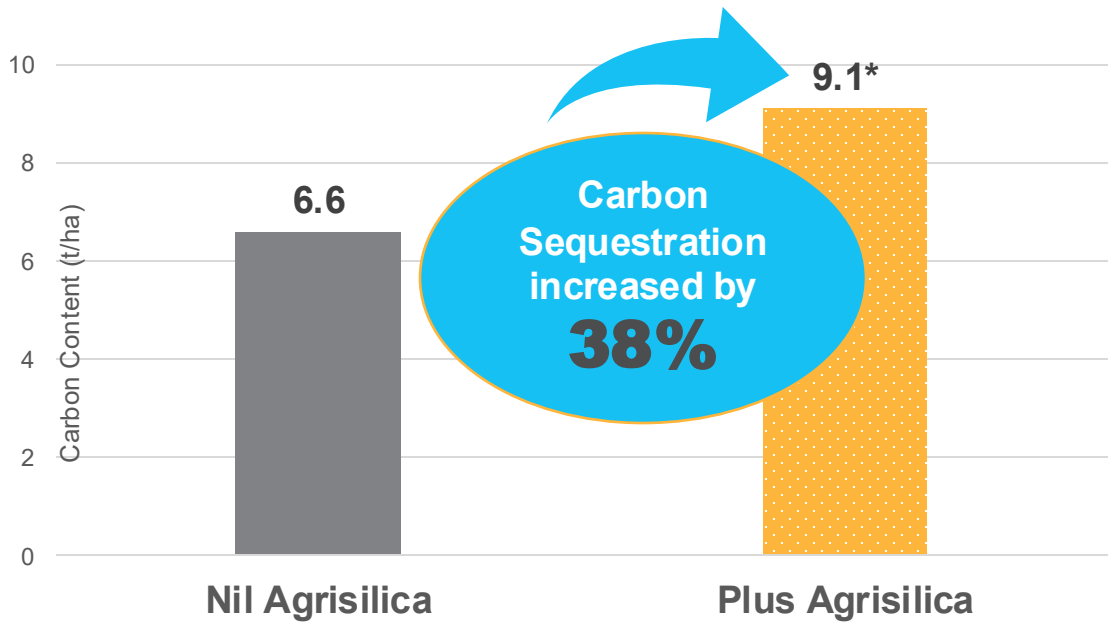
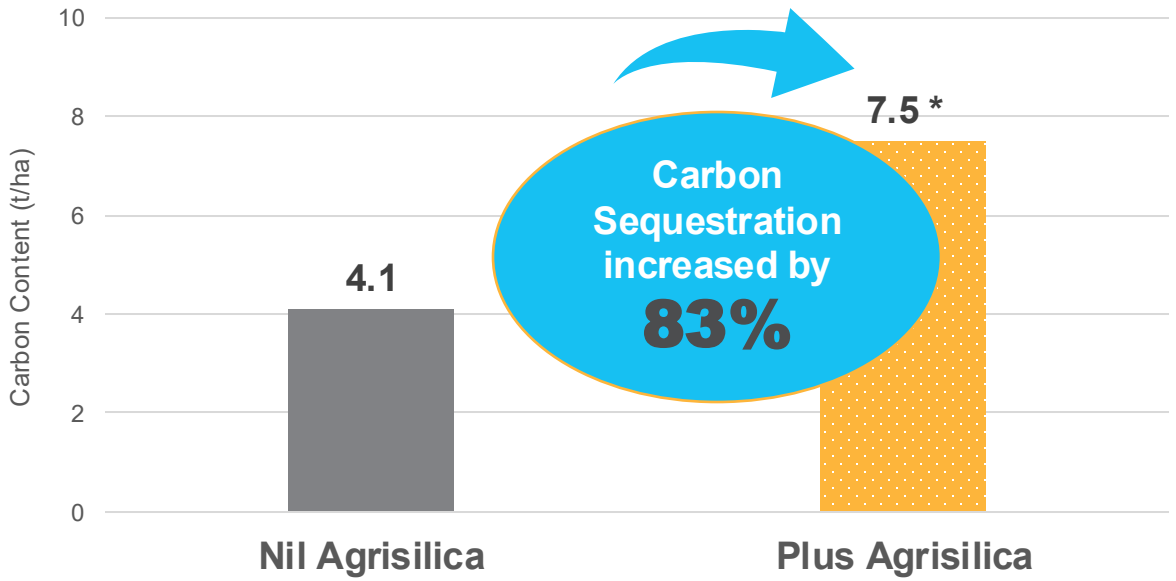
1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)

Wheat Biomass Carbon Content – Well Watered (400mm Growing Season Rainfall)



Wheat Biomass Carbon Content – Drought Conditions (200mm Growing Season Rainfall)



Above: Replicated trials conducted by Western Sydney University, Australia, proved that under both well-watered and droughted conditions, Agrisilica® significantly increased Carbon sequestration. *Indicates significance P< Johnson et al., (2022)

1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)

Key Trial Information : See Slide 9 Overleaf

Trial aim: to access the effect different application rates of amorphous silicon have on shoot biomass, carbon and silicon accumulation in wheat grown under two irrigation regimes

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Commenced: 2021
Location: Western Sydney University, NSW Australia
Manager: University of Western Sydney, Australia
Cropping System: Wheat

Agrisilica® Treatments
1. Standard Fertiliser Practice (SFP),
2. 150 kg/ha Agrisilica® + SFP
3. 300 kg/ha Agrisilica® + SFP.
4. 450 kg/ha Agrisilica® + SFP

Irrigation Treatments:
1. 400 mm / ha Growing Season Rainfall (well watered)
2. 200 mm / ha Growing Season rainfall (drought)

Standard Fertiliser Practice (SFP):
65 kg/ha N, 50kgha P_2O_5

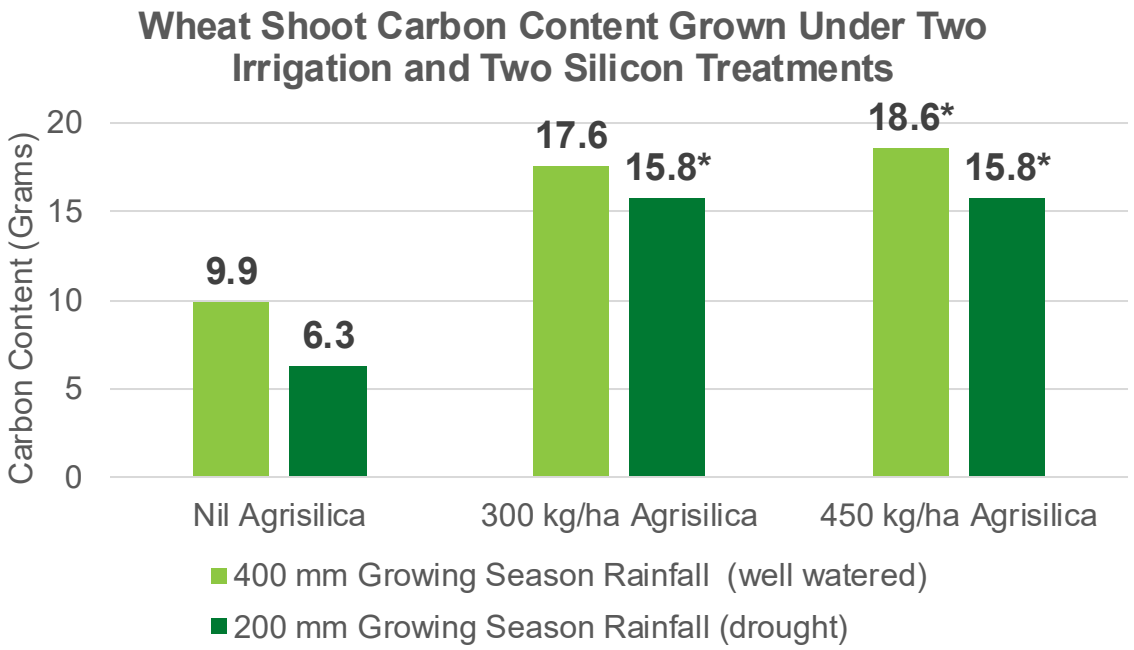
Plant Measurements Taken:
- Carbon Content
- Silicon Content

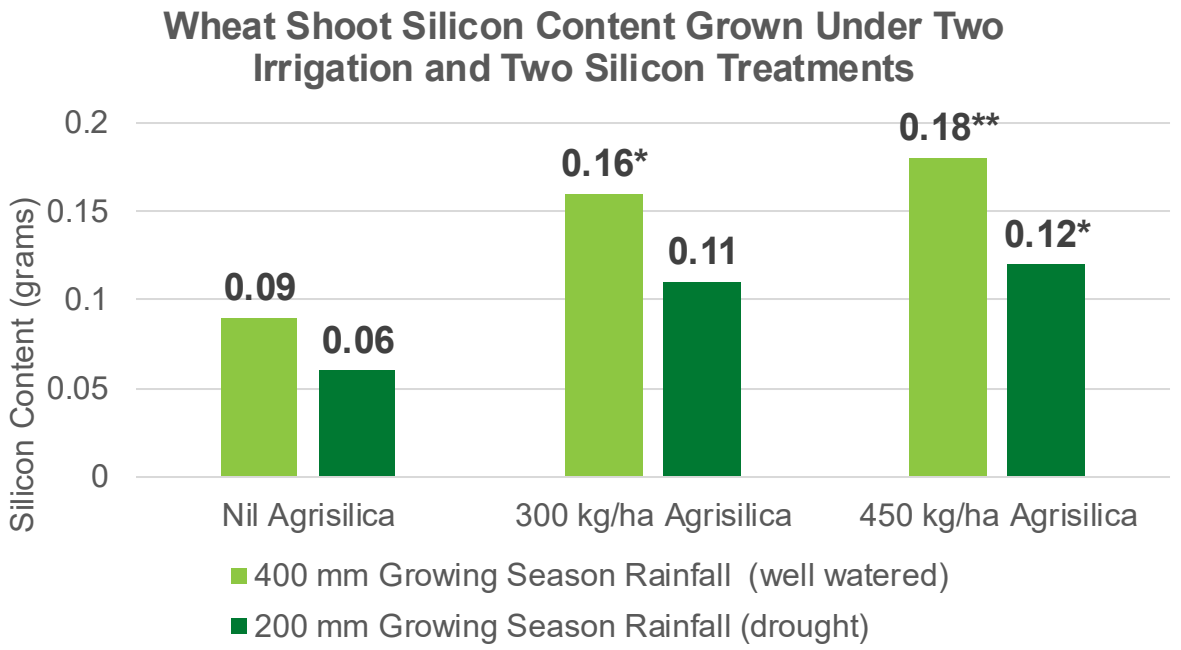
Measurements taken at harvest (2021)

Amorphous Silicon Carbon Wheat Trial (Aust) Soil Test Results Prior to Trial Commencing	
Soil Type	Loam
pH (1:2.5 Soil Water)	6.2
Nitrate N mg/kg	343
Colwell P mg/kg	18
Exchangeable Potassium kg/ha	487
CEC cmol+/kg	6.1
PAS (0.01M CaCl2) mg/kg	22.00

1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)





Wheat ***Carbon content increased by 88% and 151%*** under well-watered and drought treatment

Wheat ***Silicon content increased by 100%*** under well-watered and drought treatments

** P<0.05 and ** P<0.001 at the 95% confidence interval. Johnson SN et al. (2022)*

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1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)

Key Trial Information : See Slides 11 and 12 Overleaf

Trial Aim: to assess the production of phytoliths and phytolith-occluded carbon (PhytOC) and distribution in aerobic rice following the addition of Agrisilica.

Commenced : 2017
Location : Mandya, Karnataka, India
Manager : University of Agricultural Sciences, Bengaluru, India
Agrisilica® : Applied annually at 300 kg/ha with SFP
Standard Fertiliser Practice (SFP) : 100 kg/ha N : 50kg/ha P_2O_5 : 50kg/ha K_2O
Crop : Rice-rice (aerobic)

Treatments
1. Standard Fertiliser Practice (SFP)
2. 300 kg/ha Agrisilica® + SFP

Plant Measurements Taken:
- Leaf and Straw weight
- Grain and Husk weight
- Phytoliths % in leaf, straw, grain and husk
- Phytoliths weight
- Carbon Content in Phytolith
- Phytolith Occluded Carbon (PhytOC)
- CO2e captured

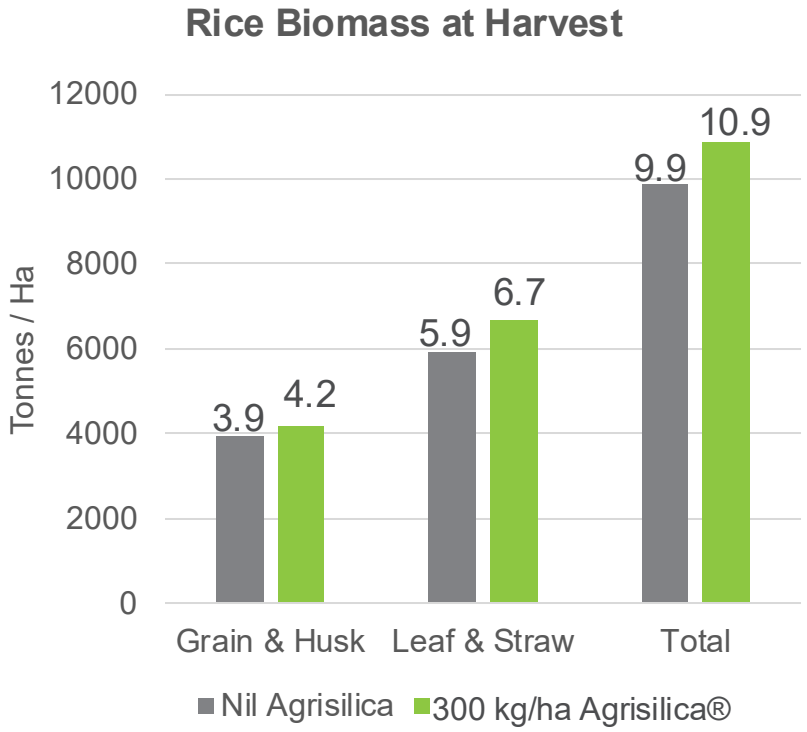
Measurements taken at harvest (2019)

Phytolith Occluded Carbon (PhytOC) Rice Trial – India **Soil Test Results Prior to Trial Commencing**	
Soil Type	Alfisol ; Sandy Loam
pH (1:2.5 Soil Water)	7.1
EC dS/m	0.22
Organic Carbon g/kg	11.7
Available N kg/ha	340.48
Available P kg/ha	203.32
Available K kg/ha	348.09
PAS (0.01M CaCl2) mg/kg	41.98

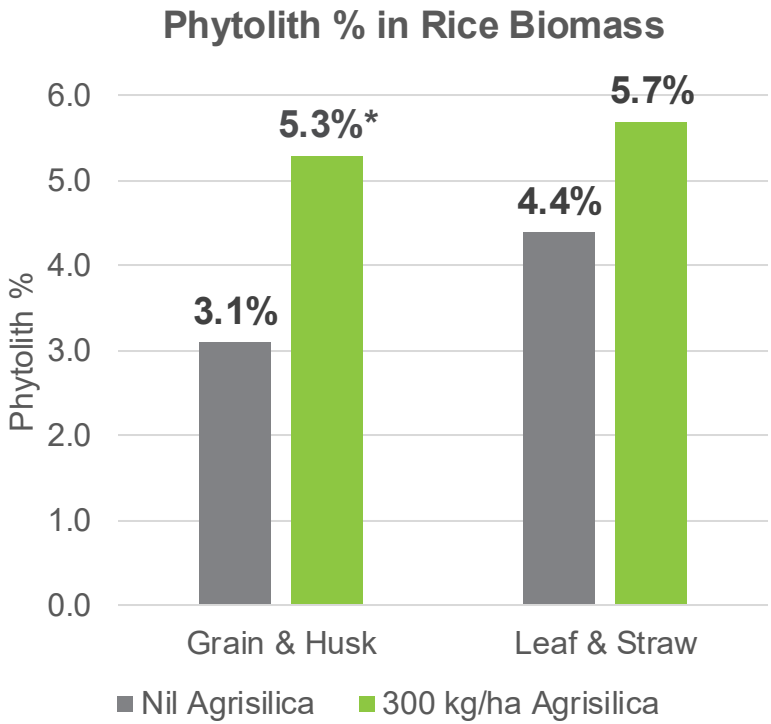
Anjum M et al., (2023)

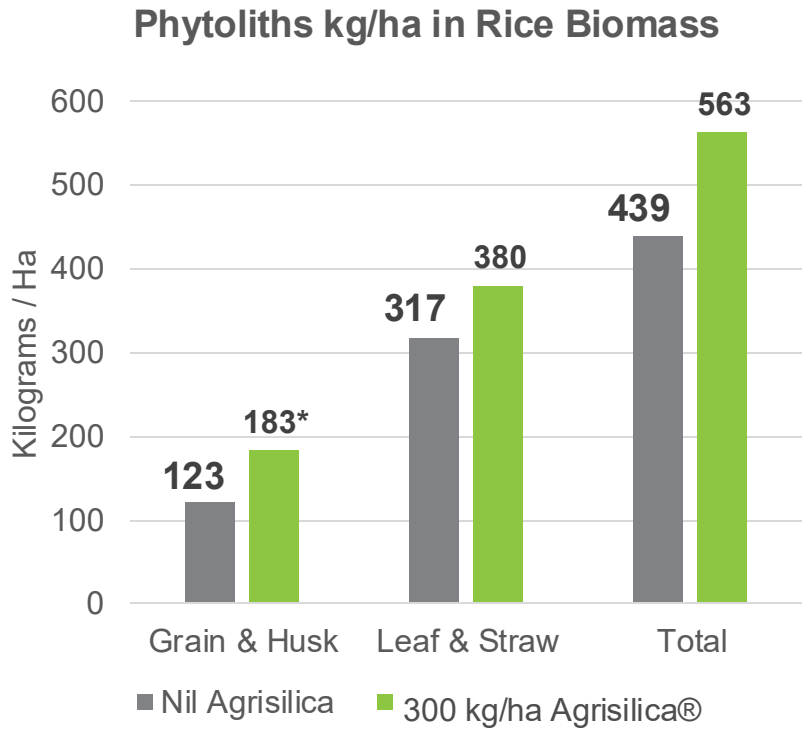
1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)



Using Agrisilica®
Grain & Husk ***weight increased by 6.6%***
Leaf & Straw ***weight increased by 12.3%***



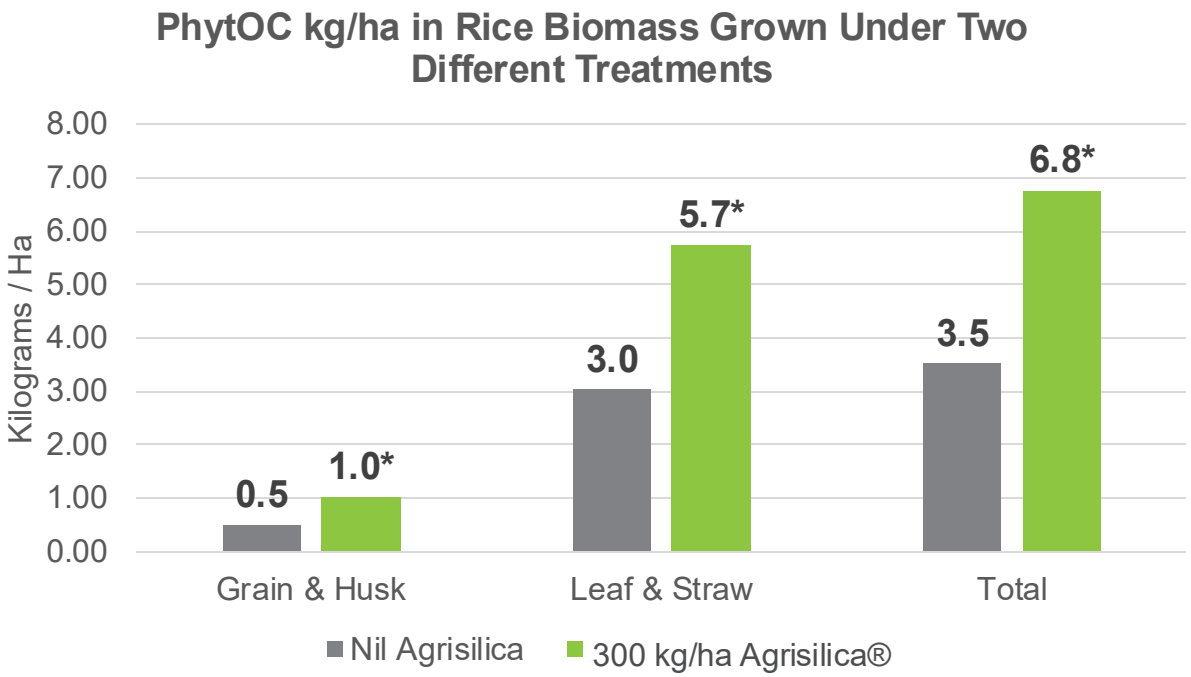


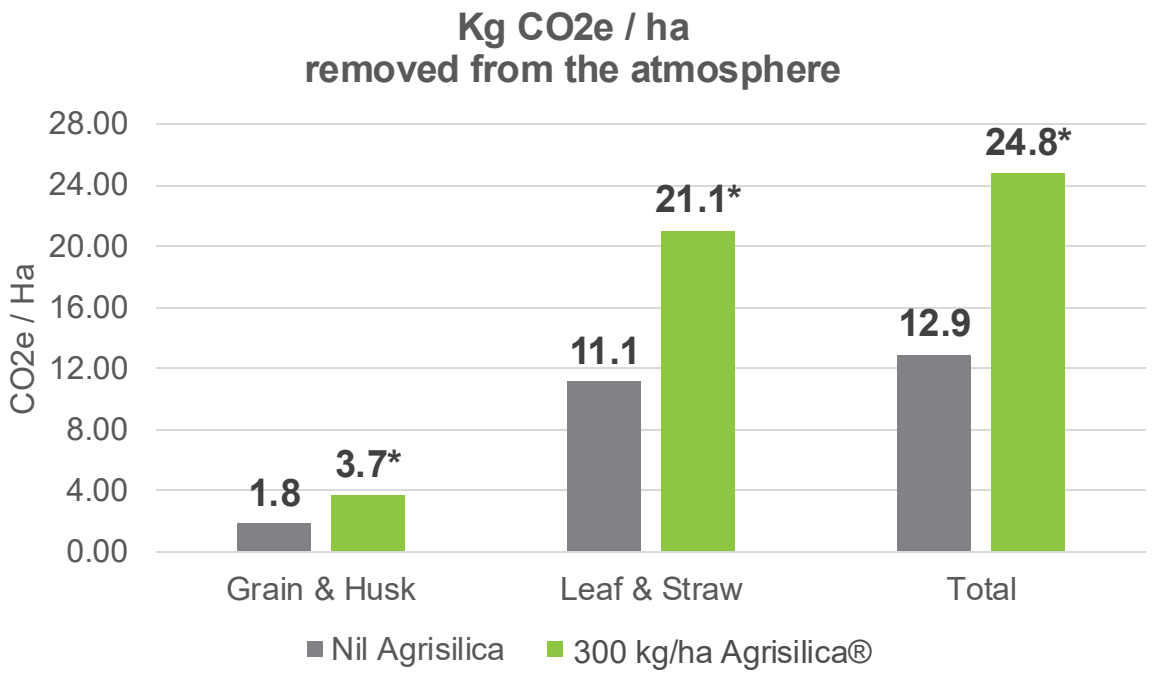
Using Agrisilica®, ***total Phytolith weight increased by 31%***, primarily in Leaf and Straw.

* Indicates significant p<0.05

1 CO2, PhytOC & Carbon Sequestration via agriculture

The importance of Plant Available Silicon (**PAS**)





Using Agrisilica® total ***PhytOC increased by 92%*** *primarily in Leaf and Straw.*
CO2e / ha ***removal increased by 92%.***

* Indicates significant $p<0.05$

2

WATER-USE EFFICIENCY

The importance of Plant Available Silicon (PAS)

2 PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)

Water is our most precious resource. Agriculture depends on it.

- Too little water, such as drought, means crop losses.
- Too much water, such as heavily irrigated crops like rice, may result in Greenhouse Gas Emissions - Methane (CH_4) and Nitrous Oxide (N_2O) - both of which are considered more dangerous than CO_2.
- Water costs can be prohibitive.
- Maintaining clean water for livestock and humans is at risk from chemical pollution.

PAS-rich fertilisers can positively impact each of the above issues, benefiting farmers, and the environment.

2 PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)

PAS has been demonstrated to improve crop tolerance to drought and improve WUE (over 60 published reports in the past 10 years).

Known Modes of Action Include

- ✓ Silicon fertilisation maintains/increases photosynthesis of plants under drought stress[1]. The result is that the crop is able to produce a higher root:shoot ratio with a proliferation of fine laterals, allowing the exploration of deeper soil strata for water and nutrients.
- ✓ Silicon is deposited in leaf epidermis (apoplast), where it forms a physical barrier reducing water loss through plant stomata and leaf [2]. During drought stress, Si increases the root hydraulic conductance and stomatal conductance but reduces cuticular transpiration, allowing more water into the cell, reducing reactive oxygen species.[3,4]
- ✓ Reduced oxidative damage (by increasing antioxidant enzyme activity) and reduced electrolyte leakage.[5]
- ✓ Altering gene expression[6]

1 Rastogi et al (2021)
2 Thorne et al. (2020)
3 Luyckx et al., (2017)
4 Coskun et al., (2019)
5 Sattar et al., (2019)
6 Shi et al. (2016)

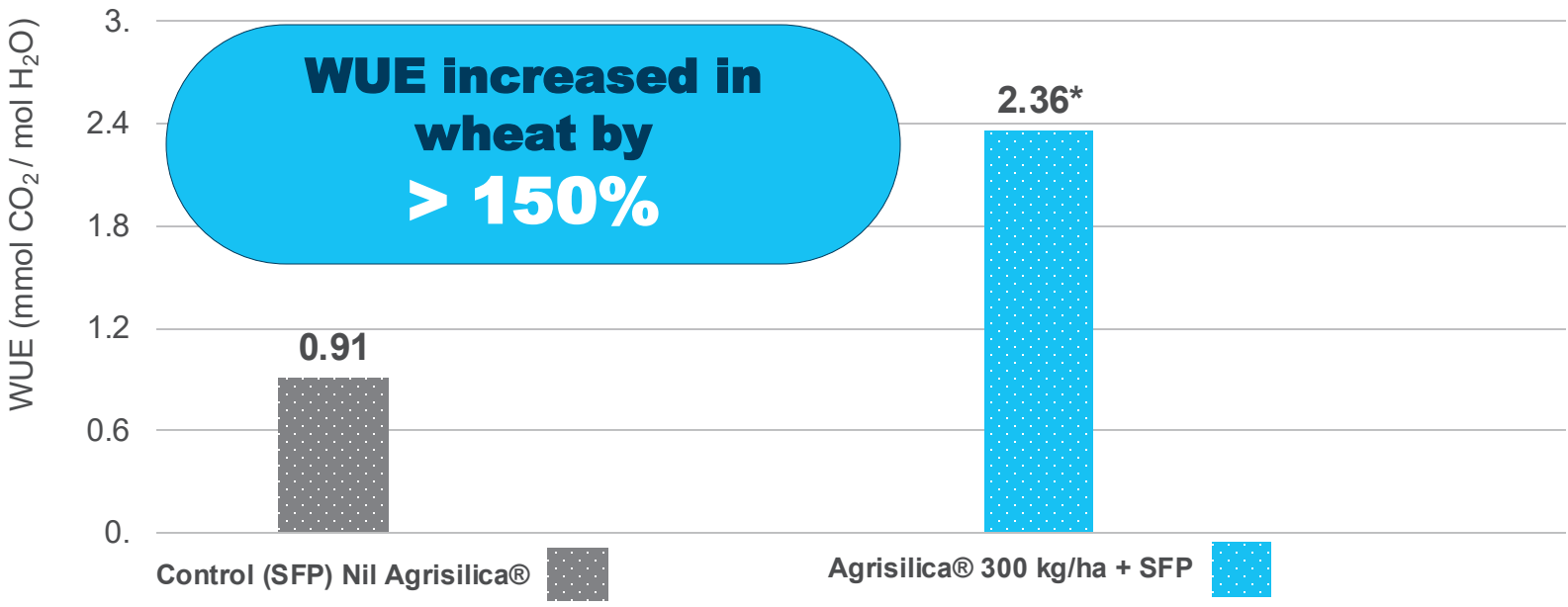
2 PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)

Silicon content in plant stem tissue at harvest significantly increased*
(>160%)

Improved WUE was due to significantly*

1. increased photosynthesis **(+98%)**
2. reduced transpiration rate **(-7%)**
3. reduced white ear damage **(-45%)**
4. and increased yield **(+61%)**



Field trial carried out by ICAR National Institute of Stress Management India

* Statistically significant difference between PAS treatments and nil PAS treatment P<0.05

Jeer et al 2021.

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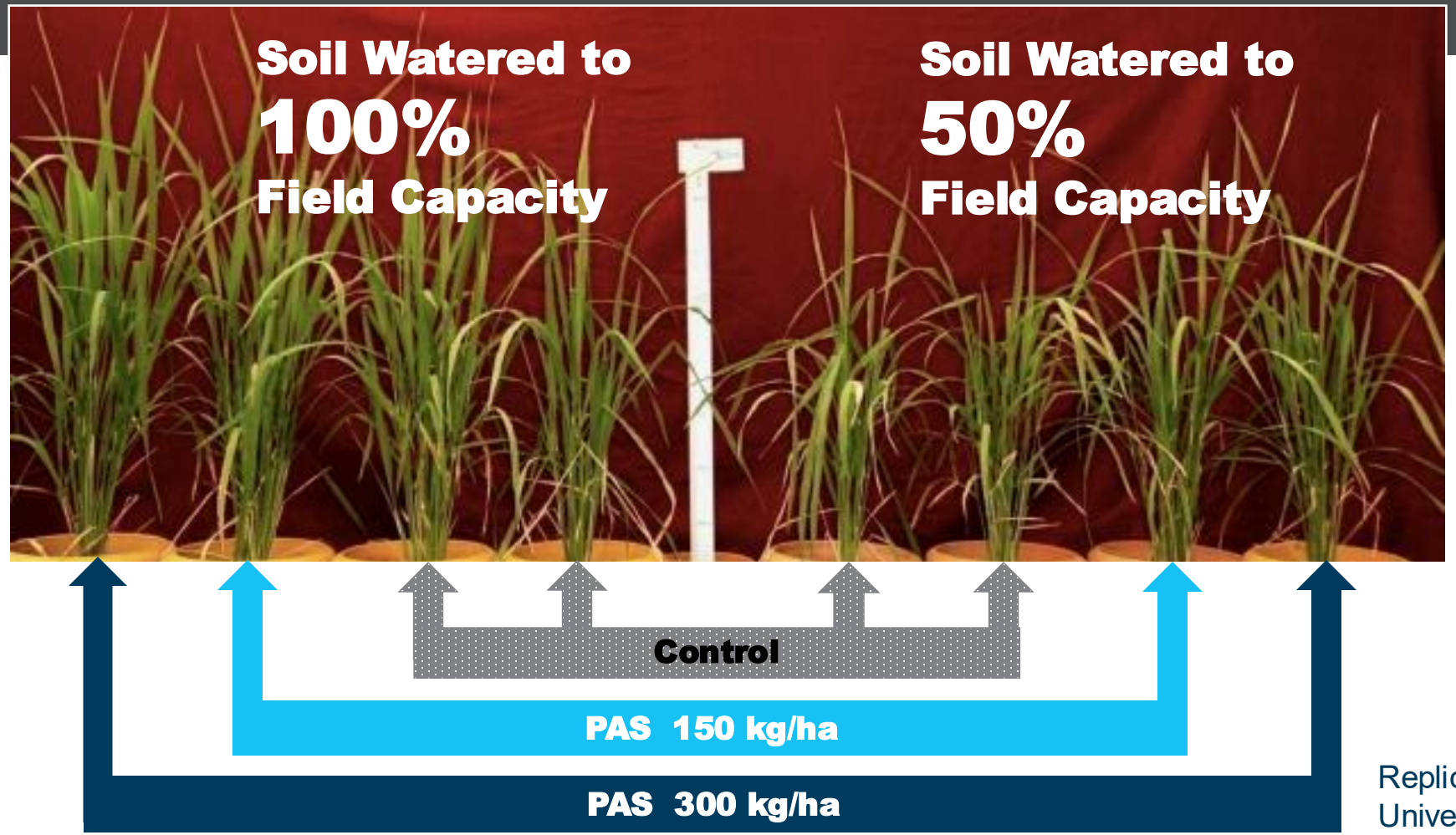
2

PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)



In both 100% and 50% Field Capacity, PAS

- **Increased leaf relative water content**
- **Increased plant height and biomass**
- **Reduced electrolyte leakage**
- **Reduced proline (plant stress marker) levels improved WUE**

Replicated Pot Trial on Rice conducted by University of Benagluru, India

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2 PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)

Key Trial Information : see Slides 19 and 20 Overleaf

Trial aim: access barley yield under there different Irrigation regimes and 2 different amorphous silica application rates

Trial Dates : Sown March 2023. Harvested July 2023
Location : Banares La Rioja Spain
Trial Manager : Universidad De La Rioja Spain
Crop : Barley Variety - Planet
Individual Plot Size : 9m x 30m

Treatments

1. Standard Fertiliser Practice (SFP)*
2. 300 kg/ha Agrisilica Silicon Fertiliser+ SFP
3. 400 kg/ha Agrisilica Silicon Fertiliser + SFP

Standard Fertiliser Practice (SFP) : 35 kg/ha N : 34kg/ha P_2O_5 : 18kg/ha K_2O

Irrigation Regimes

1. 120 Litres/m^2 (applied as 2 x 60 litres/m^2) : **100% (optimal r**ecommended irrigation rate
2. 96 Litres/m^2 (applied as 2 x 48 litres/m^2) : **80%**
3. 72 Litres/m^2 (applied as 2 x 36 litres/m^2 : **60%**

12 Plots x 4 Replicates
= 48 Plots

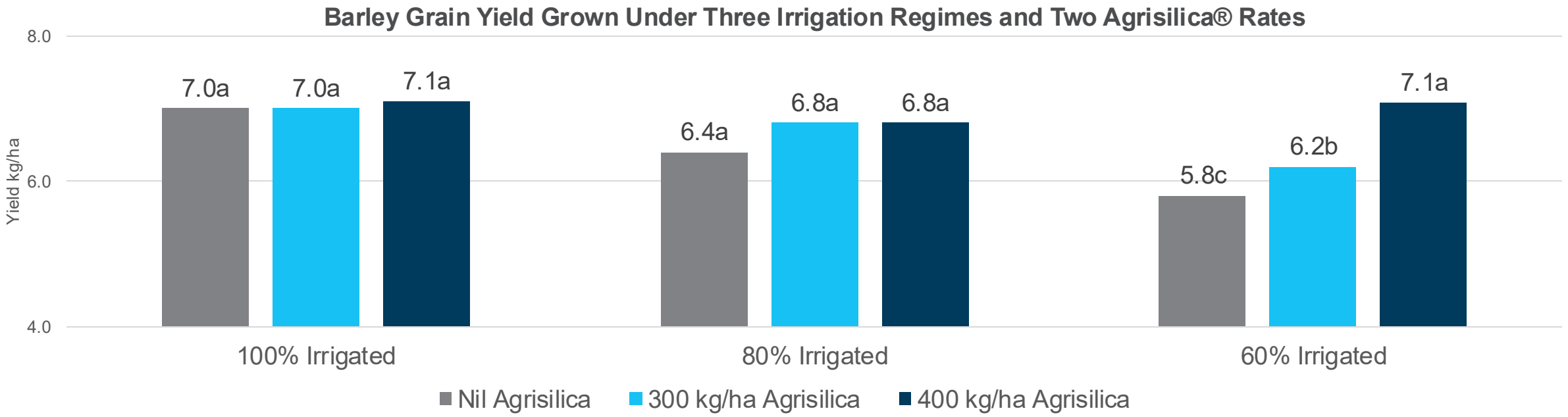
Rainfall during trial
159.8 Litres/m^2 (drier than normal)

Plant Measurements Taken :

- Yield
- Water Use Efficiency (kg yield/mm irrigation)

Soil Test	
Soil Type	Loam
pH 1/5	7.1
Organic Matter	1.85%
EC	0.16 dS/m
Phosphorus (Olsen)	93 mg/kg
Potassium	201 mg/kg
Calcium	1926 mg/kg

2 PAS Increases Water-Use Efficiency (WUE)

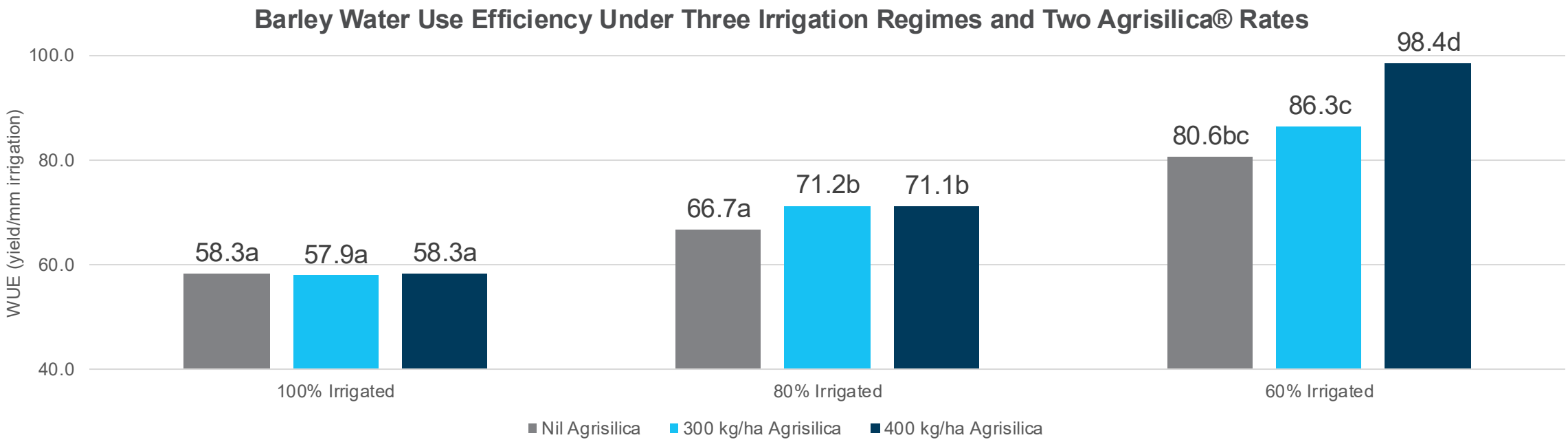


Using 400kg/ha Agrisilica® yield of Barley grown at 60% irrigation was ***increased by 22% compared to Nil Agrisilica***
Using 400 kg/ha Agrisilica®, the yield of Barley was maintained when irrigation was applied at 60%
of the recommended rate compared to the 100% Irrigation rate.

The same letters show no significant difference (P=0.05 MDS)

2 PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)



Using Agrisilica®, Water Use Efficiency (yield/mm rainfall) increased significantly when irrigation was suboptimal.
Compared with 100% irrigated with Nil Agrisilica®, ***WUE increased by >68%***
when 400kg/ha Agrisilica® was used with 60% irrigation.

The same letters show no significant difference (P=0.05 MDS)

2

PAS Increases Water-Use Efficiency (WUE)

The importance of Plant Available Silicon (**PAS**)

Key Trial Information : **see Slide 22 Overleaf**

Trial aim: to access the effect different application rates of amorphous silicon have on wheat yield and WUE

Trial Commenced : 2021
Location : Western Sydney University NSW Australia
Trial Manager : University of Western Sydney Australia
Crop : Wheat (Sunflex)

Agrisilica® Treatments
1. Standard Fertiliser Practice (SFP),
2. 150 kg/ha Agrisilica) + SFP.
3. 300 kg/ha Agrisilica + SFP.
4. 450 kg/ha Agrisilica + SFP

Standard Fertiliser Practice (SFP) :
65 kg/ha N, 50kgha P_2O_5

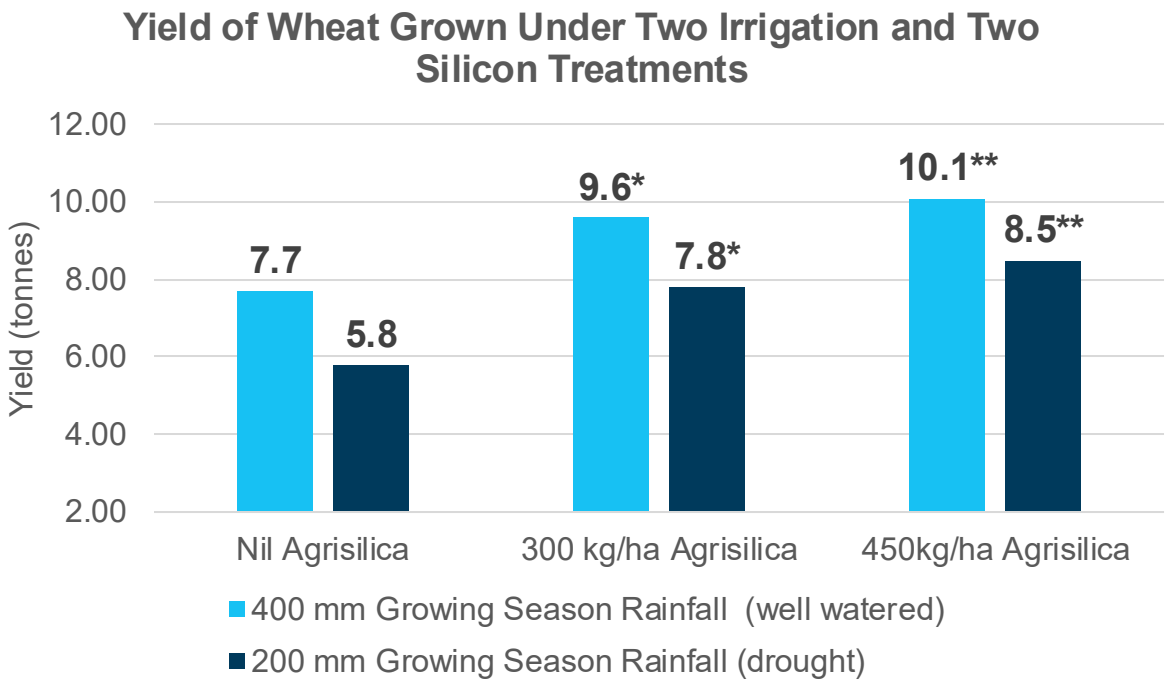
Irrigation Treatments :
1. 400 mm /ha Growing Season Rainfall (well watered),
2. 200 mm /ha Growing Season rainfall (drought)

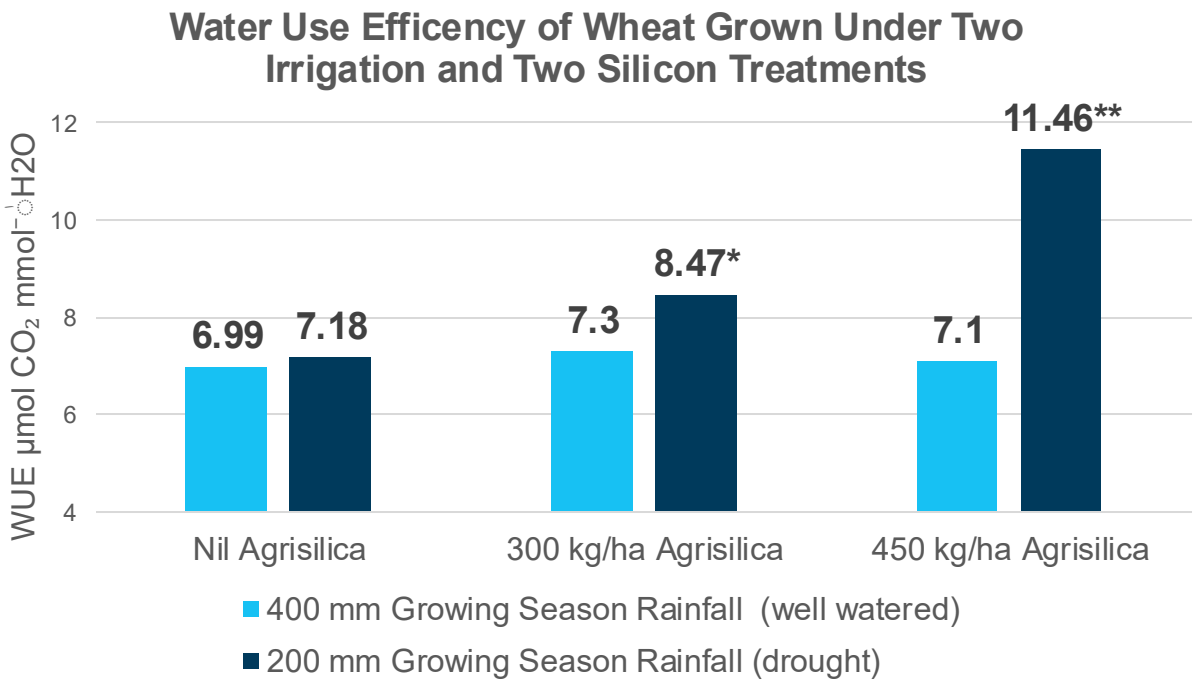
Plant Measurements Taken :
- Yield
- WUE (Photosynthesis Rate / Transpiration Rate)

Soil Test Results Prior to Trial Commencing	
Soil Type	Loam
pH (1:2.5 Soil Water)	6.2
Nitrate N mg/kg	343
Colwell P mg/kg	18
Exchangeable Potassium kg/ha	487
CEC cmol+/kg	6.1
Silicon (0.01M $CaCl_2$) mg/kg	22.00

2 PAS Increases Water-Use Efficiency (WUE)

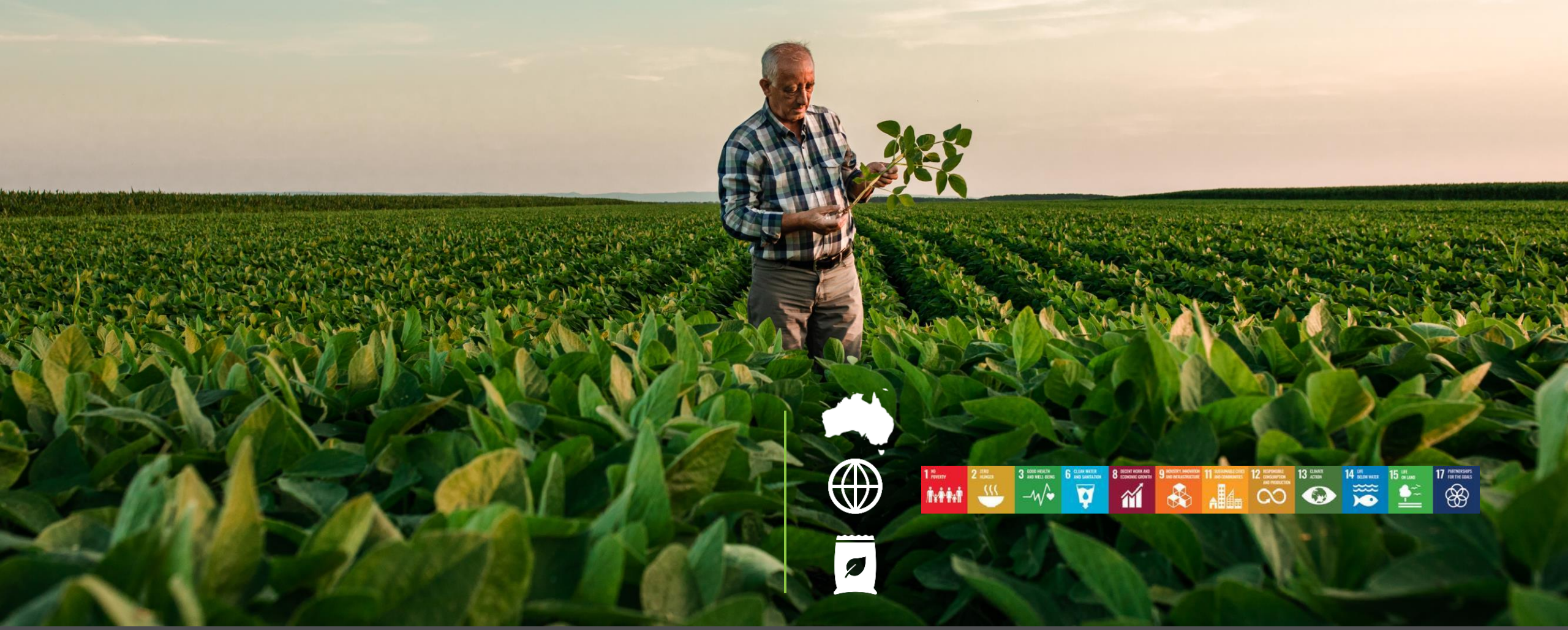
The importance of Plant Available Silicon (**PAS**)





Using Agrisilica®, wheat yield and WUE increased significantly. Using 450kg/ha Agrisilica® under drought conditions (200mm GSR) ***WUE increased by 64%*** compared to Nil Agrisilica® under non-drought conditions (400 mm/ha GSR)

** P<0.05 and ** P<0.001 at the 95% confidence interval Johnson S.N. et al. (2022)*



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