Genetic Dissection of Drought Adaptive Mechanisms in Bread and Durum Wheat through Large Scale Phenotyping Methodologies

Collaborators

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Project Rationale

- Dissection of drought adaptive mechanisms
- Utilizing 3 mapping populations
- Phenotyped under multiple environments

Populations:

- Kukri / RAC875
- Excalibur / Kukri
- Atil / *Triticum dicoccum*

Environments:

- Mexico
- Australia
- India

- Controlled environment studies
- New mapping populations

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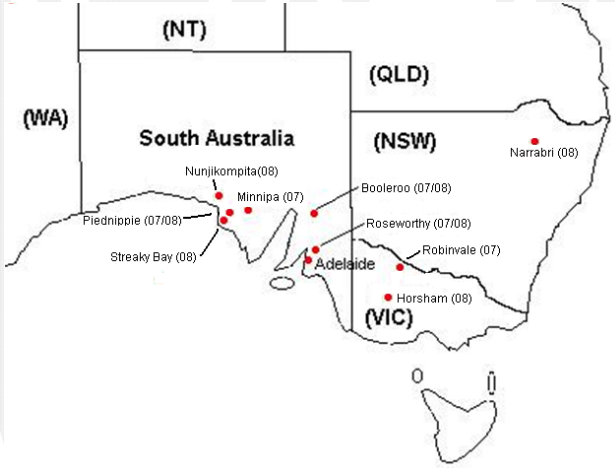
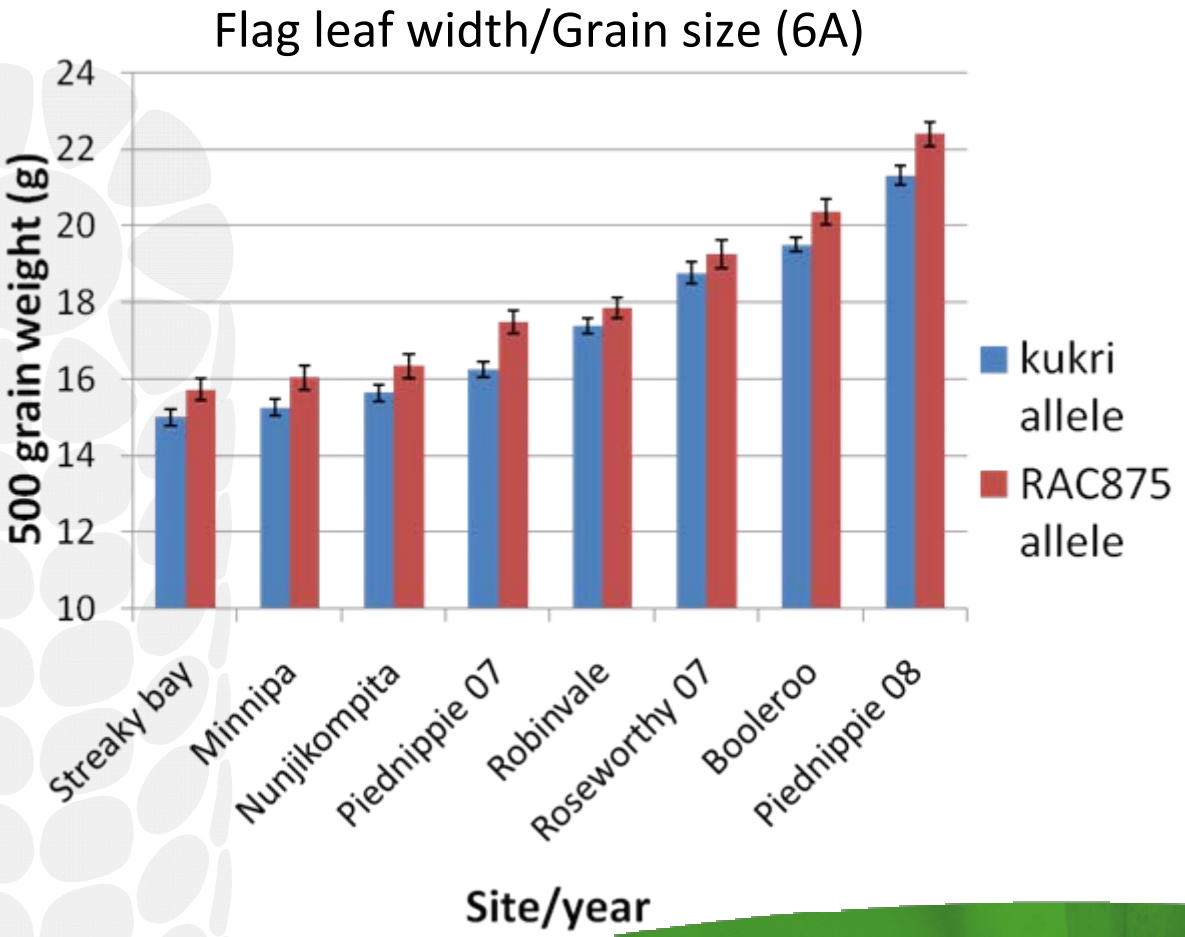
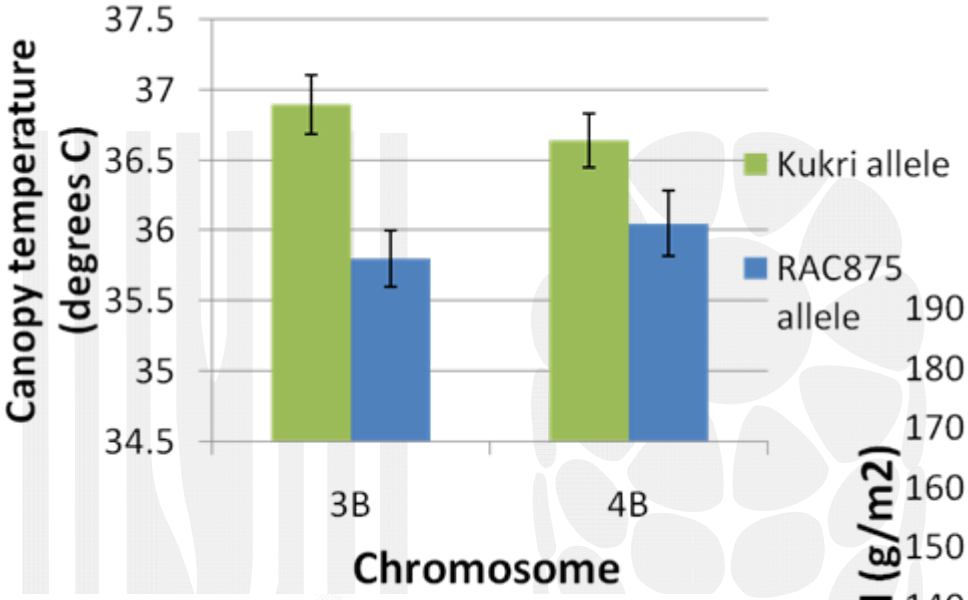
Kukri/RAC875

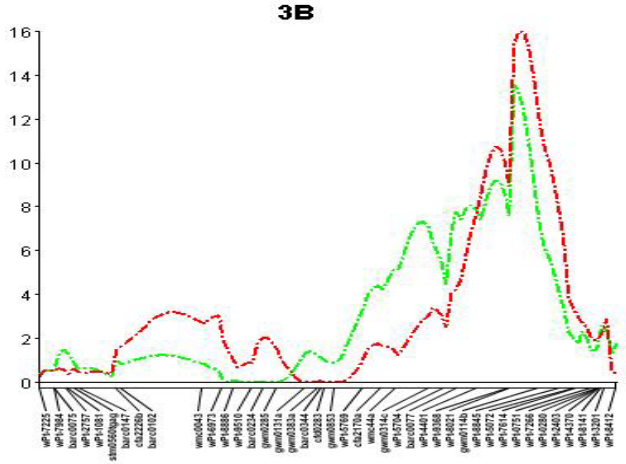
	QTL Targeted for Fine Mapping
3B	Yield under heat stress (12% variation), canopy temperature
6A	Flag leaf width, Grain size, Early vigor
7A	Yield, Grain number



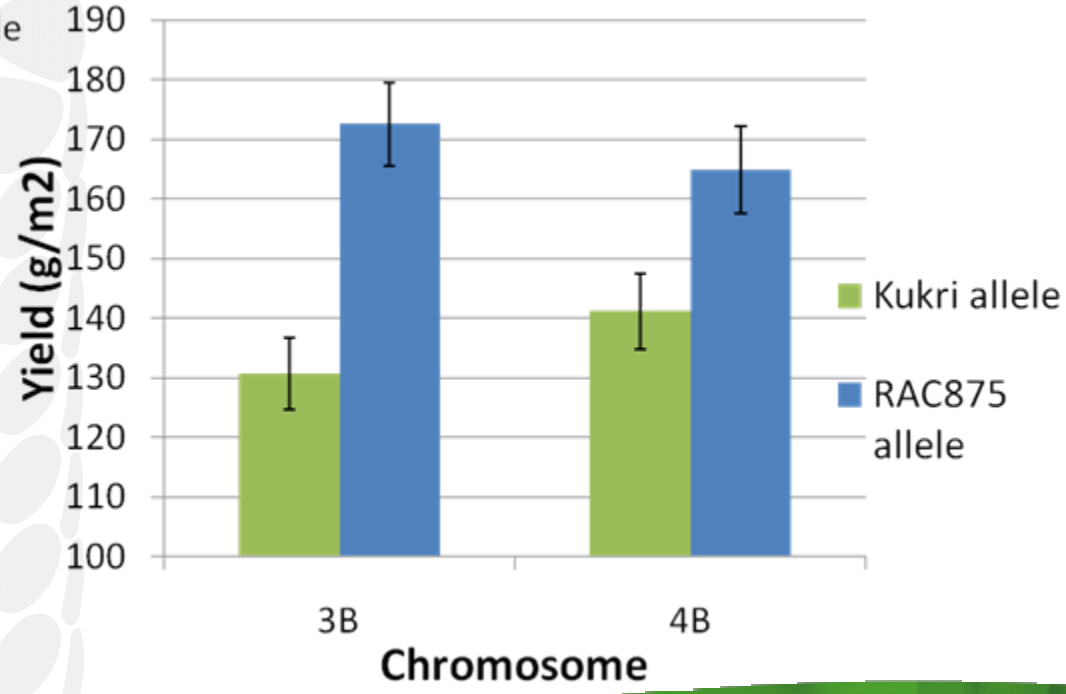


Kukri/RAC875: CT and Yield (QTLs on 3B & 4B)





Red line - CT Green - Yield



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Excalibur / Kukri

Four major maturity QTL identified:

2BS – Ppd-B1
4AL – Earliness per se
5AL – Vrn-A1 gene
7AS – Photoperiod gene with vernalisation response (TaFT/Vrn3)

QTL Targeted for Fine Mapping	
1B	Yield (13% variation), Grain size, Tipping, Grain filling duration
6A	Yield, Grain size, Tipping, HI, Wax, Crown rot
7A	Yield, Grain number

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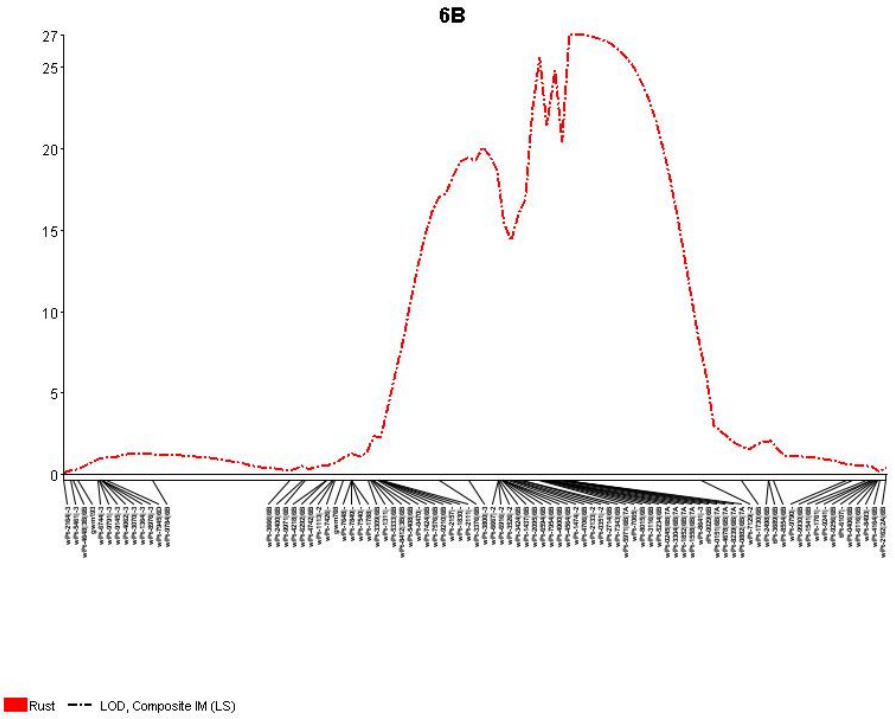
Atil / *T. dicoccum*

Map details

27 linkage groups
894 markers (853 DArT)
2129 cM (Av 2.4 cM)
8 environments



Traits of interest:

Rust
Early vigour / NDVI
Chlorophyll content
Yield components under heat stress

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High through-put phenotyping

Physiological breeding: strategic crossing for drought

YLD = **WU** x **WUE** x **HI** (Passioura, 1979)

Photo-Protection

Leaf morphology

- wax/pubescence
- posture/rolling

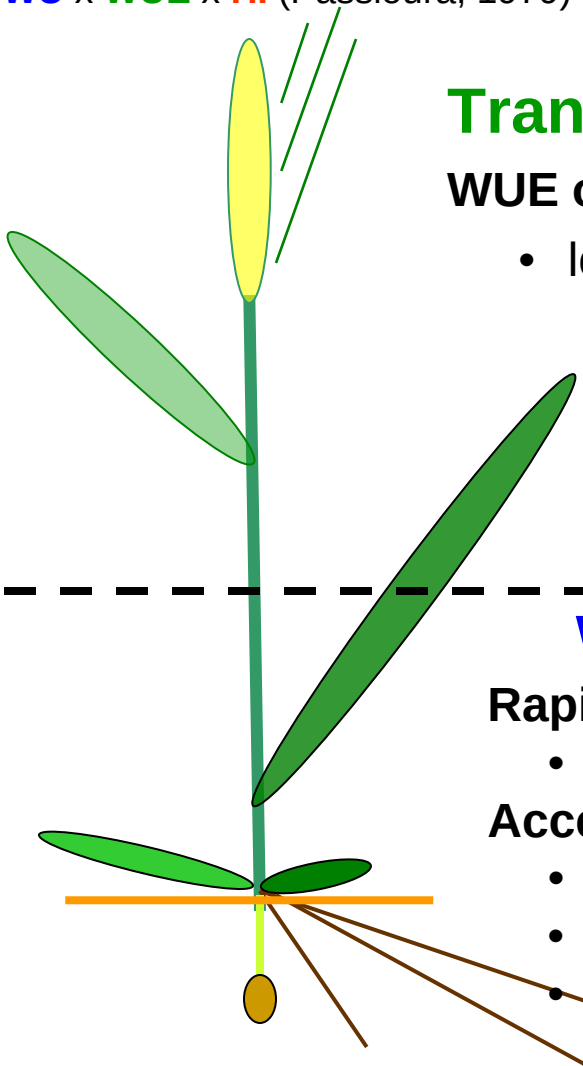
Pigments

- chl a:b
- carotenoids

Transpiration Efficiency

WUE of leaf photosynthesis

- low 12/13C discrimination



Partitioning (HI)

Partitioning to stem carbohydrates

Harvest index

- *Rht* alleles

Water Uptake

Rapid ground cover

- protects soil moisture

Access to water by roots

- Ψ leaf
- cool leaves
- (osmotic adjustment)

High through-put phenotyping

Field environments:

Seri/Babax
Drought - 2002, 2005
Irrigated - 2002, 2005

SAWYT
Drought - 2005, 2006, 2007
Irrigated - 2005, 2006, 2007

Significant correlations with controlled enviro:

- Grain number
- Grain weight
- SPAD (WUE)
- Leaf rolling (WUE)
- Flag leaf wax (WUE)
- Height (HI)

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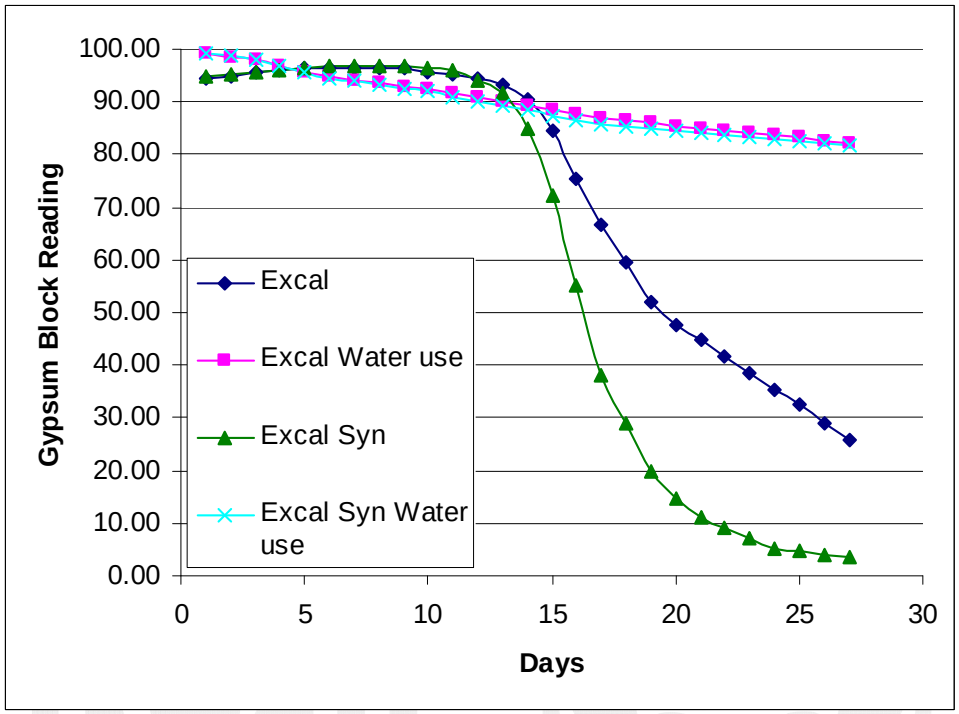
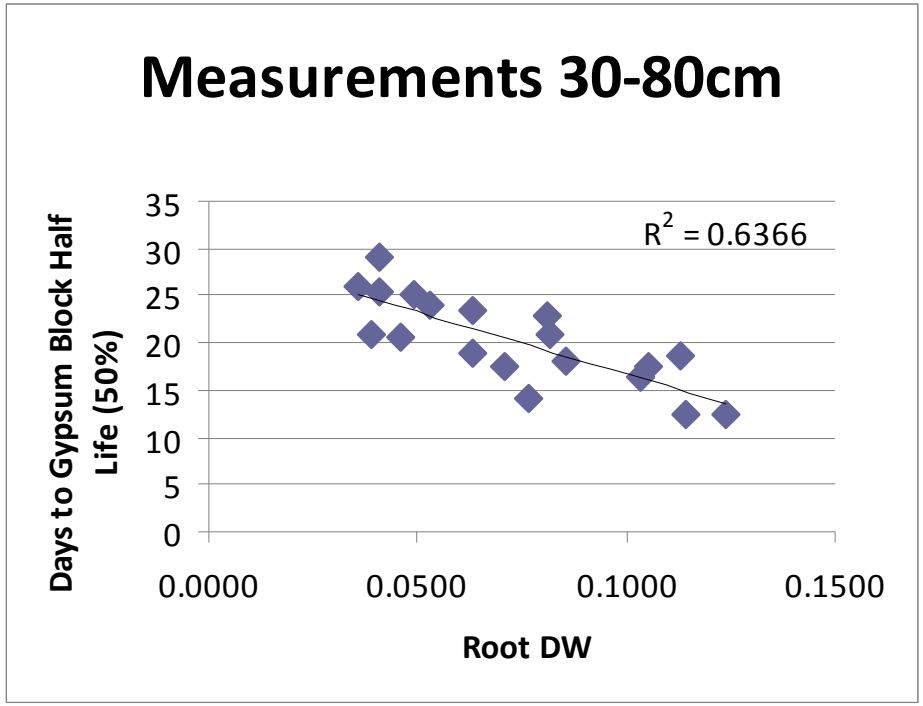
High through-put phenotyping



Improved Water Uptake



<u>Root depth screening</u>:

- Genotypes with known difference in root depth in the field
- High correlation between water extraction measured by gypsum blocks and roots at depth in 1m tubes in the GH

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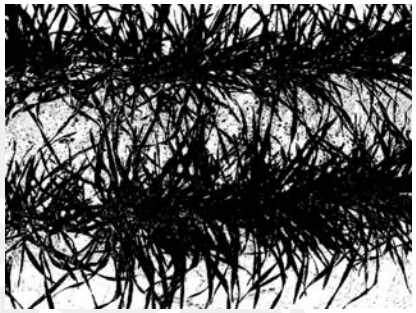
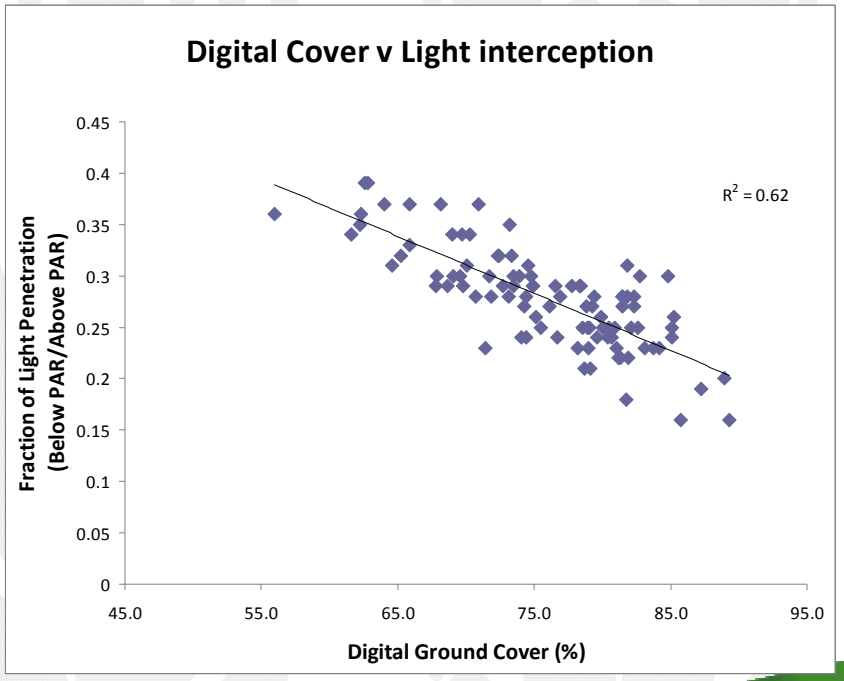
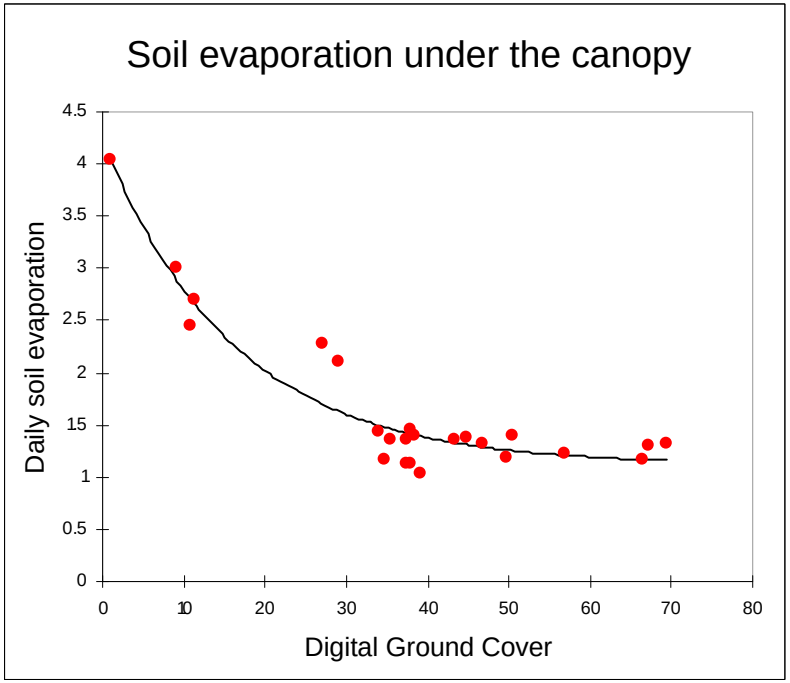
High through-put phenotyping in field



Improved Water Uptake





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On-going Activities

1) Large scale phenotyping in Australia and Mexico for fine mapping

2) Genome analysis of Atil/T. dicoccum RIL population

3) New population development (markers)

4) Phenotyping of mapping populations India (Karnal, Pune)

Project linkages and Data release

Products to be generated:
1) Improved phenotyping methodologies
2) QTL identification for MAS
3) Improved drought adaptive cultivars
4) New germplasm source with valuable drought adaptive traits for use in breeding

Data release in the form:
- Publication
- Seed
- Data distribution

Adoption via collaborating institutions:
- CIMMYT
- ACPFG
- DWR / ARI
- ICARDA
- Iran
- Morocco
- Other wheat research institutes worldwide

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