



**Candidate genes in the major QTL *Phosphorus uptake 1 (Pup1)*
and marker-assisted breeding of *Pup1* rice varieties**

Sigrid Heuer, GCP ARM, Mali, Sept 23 2009

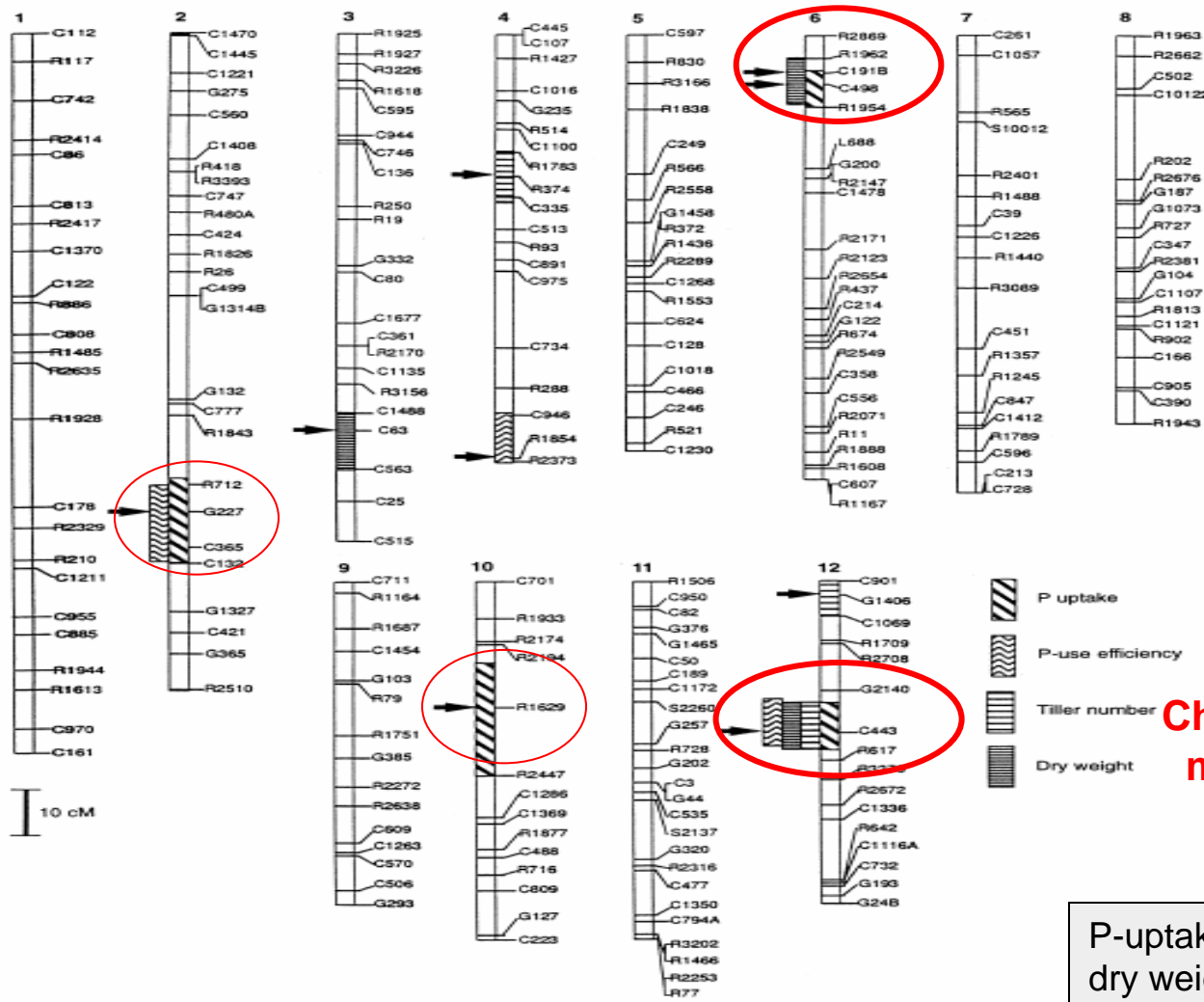
- 1. Commissioned SP3 (2008-2009): Application and Validation of the Major QTL Phosphate Uptake 1 (*Pup1*)** (G4008.41)
- 2. Competitive SP2 (2009-2011): Drought from a Different Perspective: Improved Tolerance through Phosphorus Acquisition** (G3008.04)

+P

-P

Pup1 is a major QTL for P-uptake located on Chr. 12

Wissuwa et al 1998

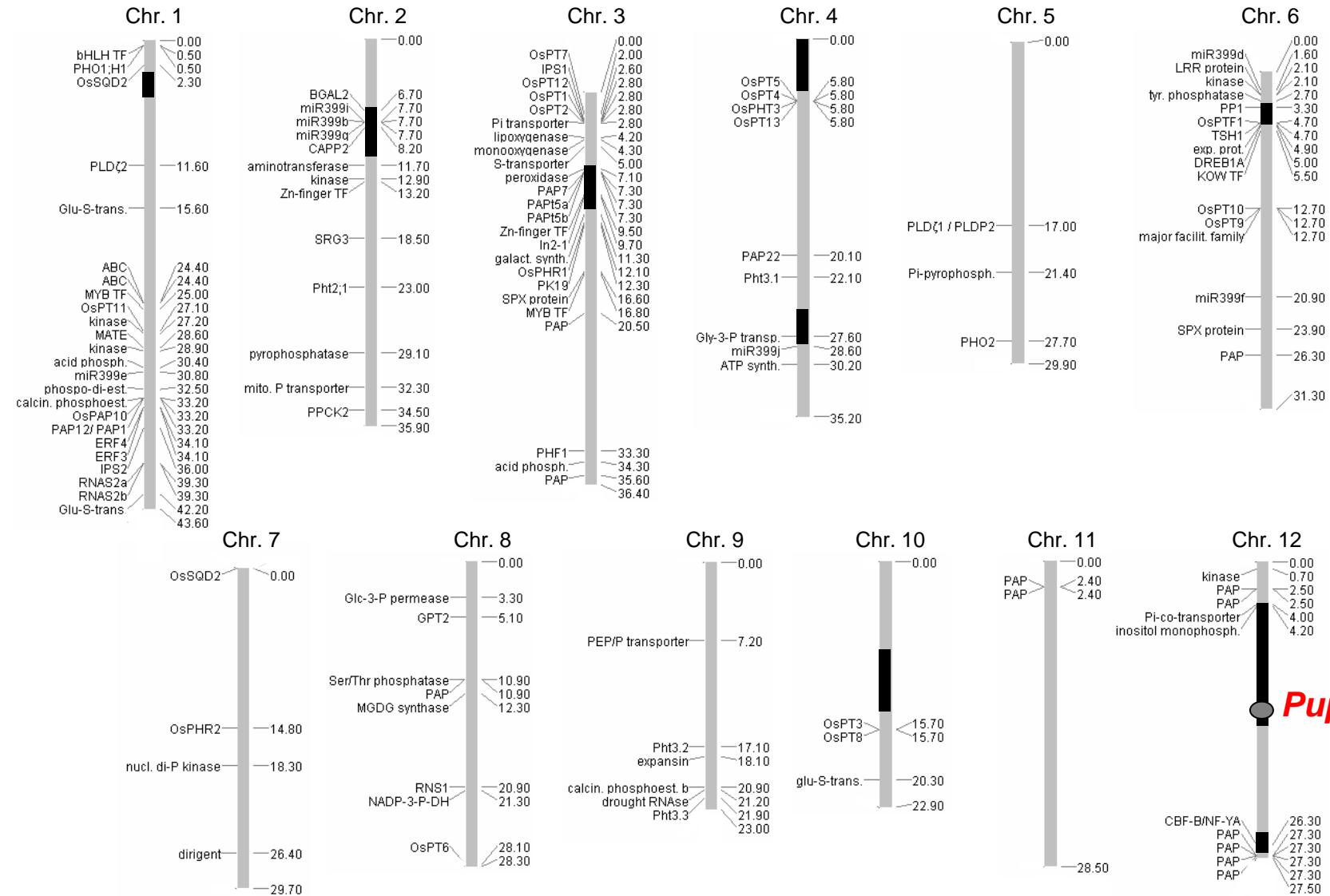


**Chr 6:
intermediate
QTL**

**Chr 12: *Pup1*
major QTL**

P-uptake:	LOD 10.7 (28%)
dry weight:	LOD 10.5 (27%)
tiller number:	LOD 7.9 (21%)
(P-use efficiency: LOD 6.6 (19%) Nipponbare allele)	

Genetic map of P-responsive genes in rice: No gene in *Pup1* region

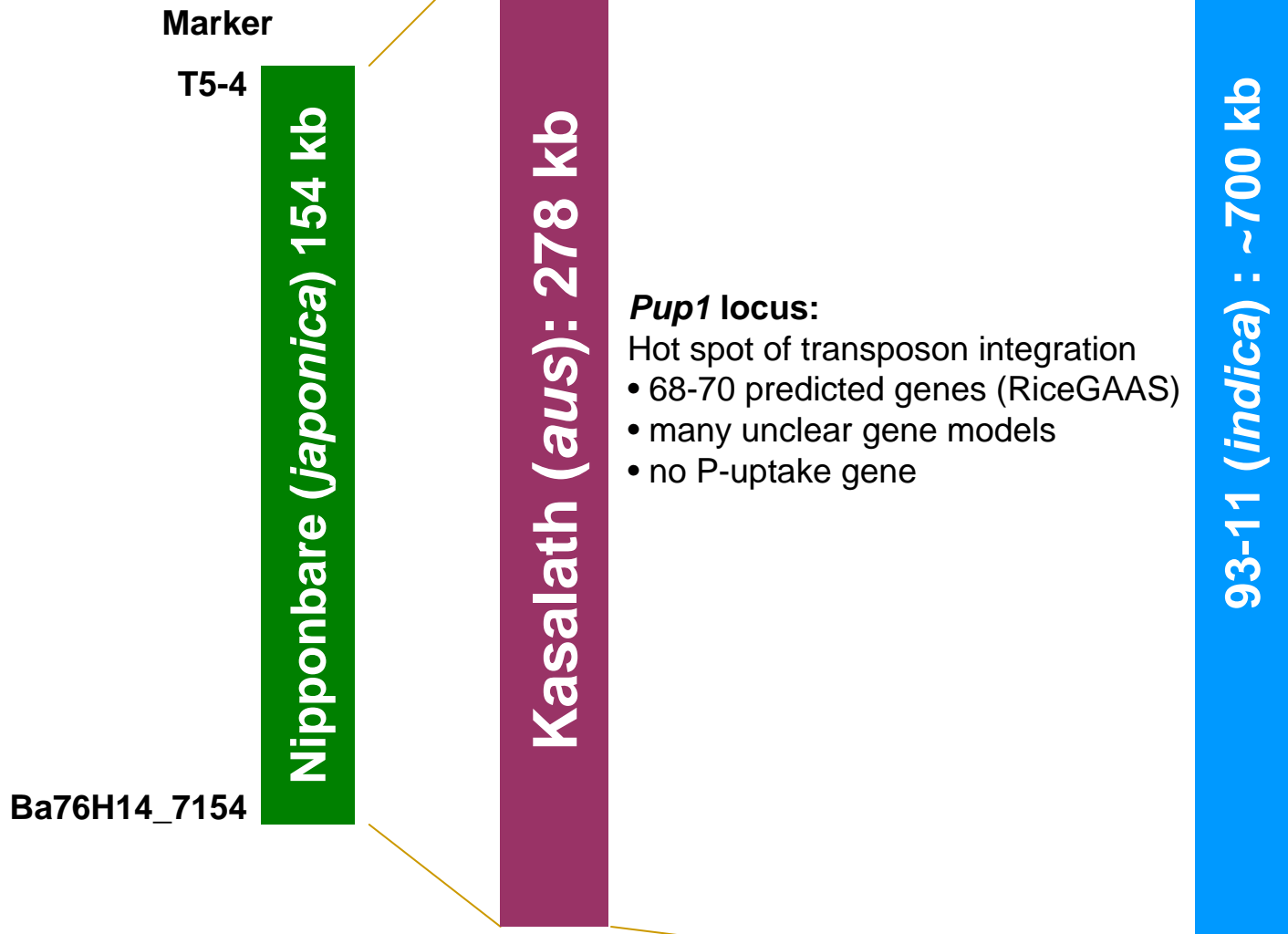


OsPTF1
Yi et al 2005

Ongoing:
Pyramiding
with *Pup1*

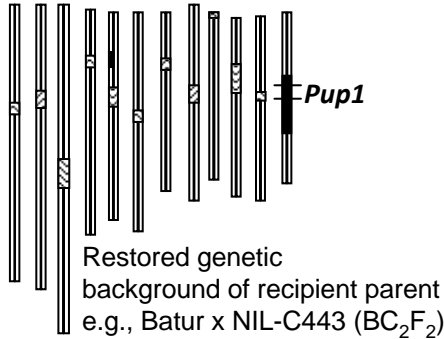
Likewise:
Physiological and phenological studies did not reveal mode of function of *Pup1*

Sequencing of the *Pup1* genomic region in the tolerant donor Kasalath



Development of *Pup1* varieties for Indonesian uplands by MABC:

1. Batur-*Pup1*
2. Situ Bagendit-*Pup1*
3. Dodokan-*Pup1*



Field experiments in Indonesia (WS 2009):

- (i) Lampung (Tamanbogo), West Sumata
- (ii) Jasinga (Java)



Jasinga:
Al toxicity, stress too severe



Lampung:
very mild stress



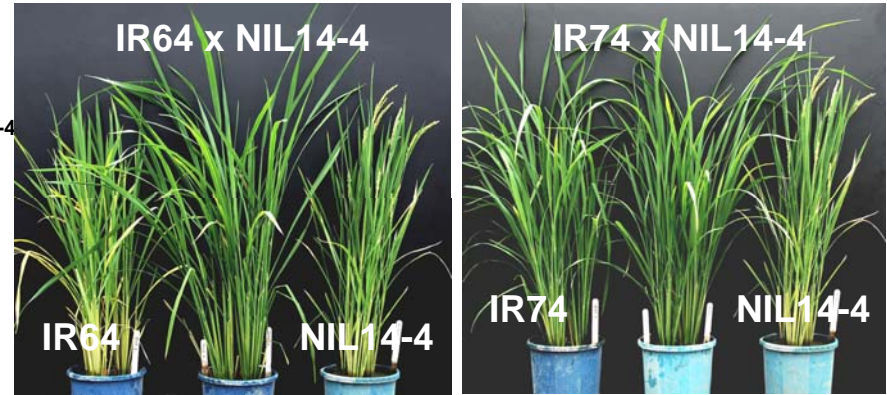
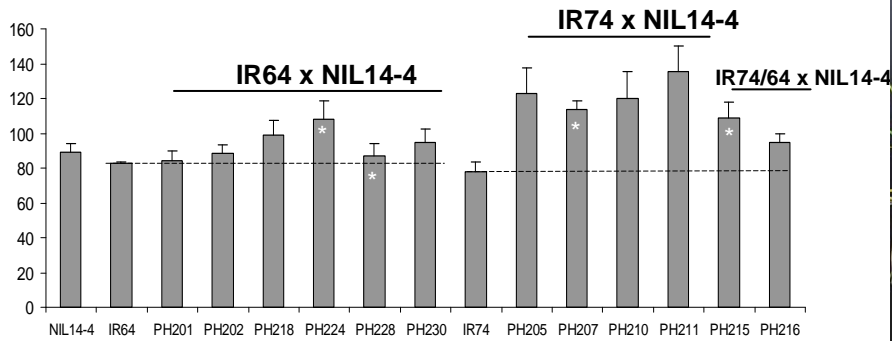
Pup1 is partially present in Indonesian recipient parent

Kas gene marker variety	5n Kasgene5 NK C	19n Kasgene1 6 C	21n Kasgene1 8 C	23n Kasgene1 9 C2	30n p26-1	42n p39	46n p43	48n p45	52n p50	3'-2 Ba76H14 7154
Batur	N	N	N	-	K	K	K	N	N	K
Situ Bagendit	K	K	N	N	N	N	K	N	N	K
Dodokan	K	K	K	K	-	K	N	N	N	N
Kasalath	K	K	K	K	K	K	K	K	K	K

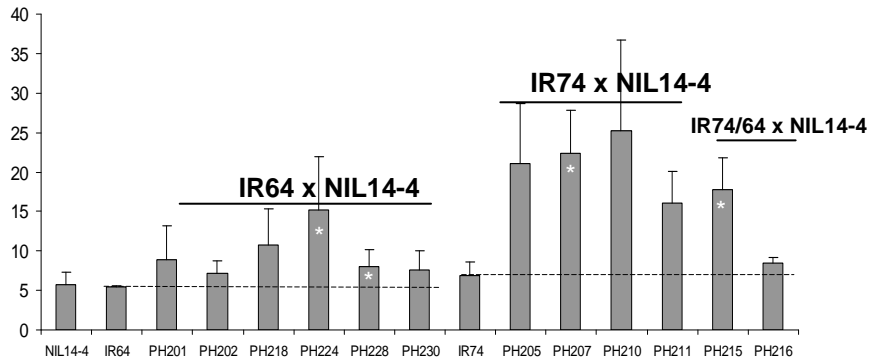
- Data are now being analyzed
- Foreground mapping with additional *Pup1* markers

Pup1 in irrigated *indica* varieties: IR64-*Pup1* and IR74-*Pup1* (BC₂F₁) breeding lines

Plant height (cm)

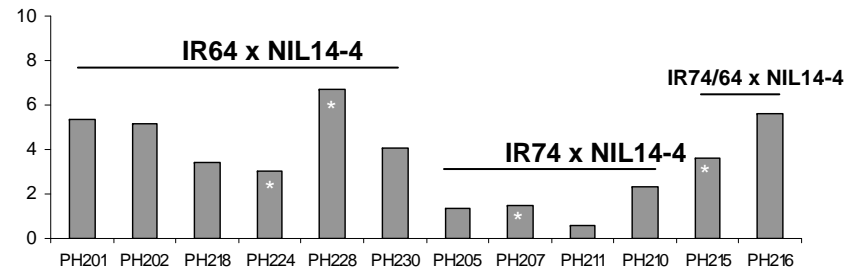


Tiller number plant⁻¹



Leaf chlorophyll (SPAD):

Increase over best parent (NIL14-4)

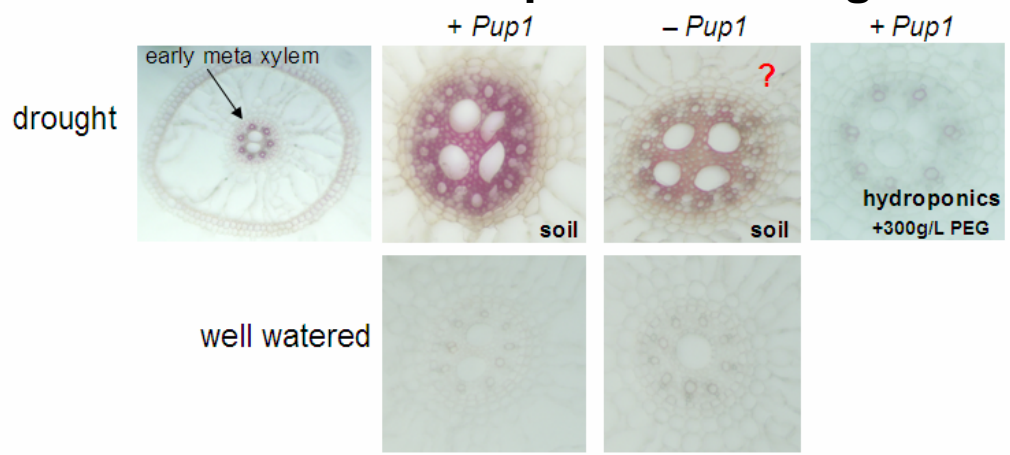


Next steps:

- Genotyping (foreground and background)
- Seed increase
- Field testing in 2010

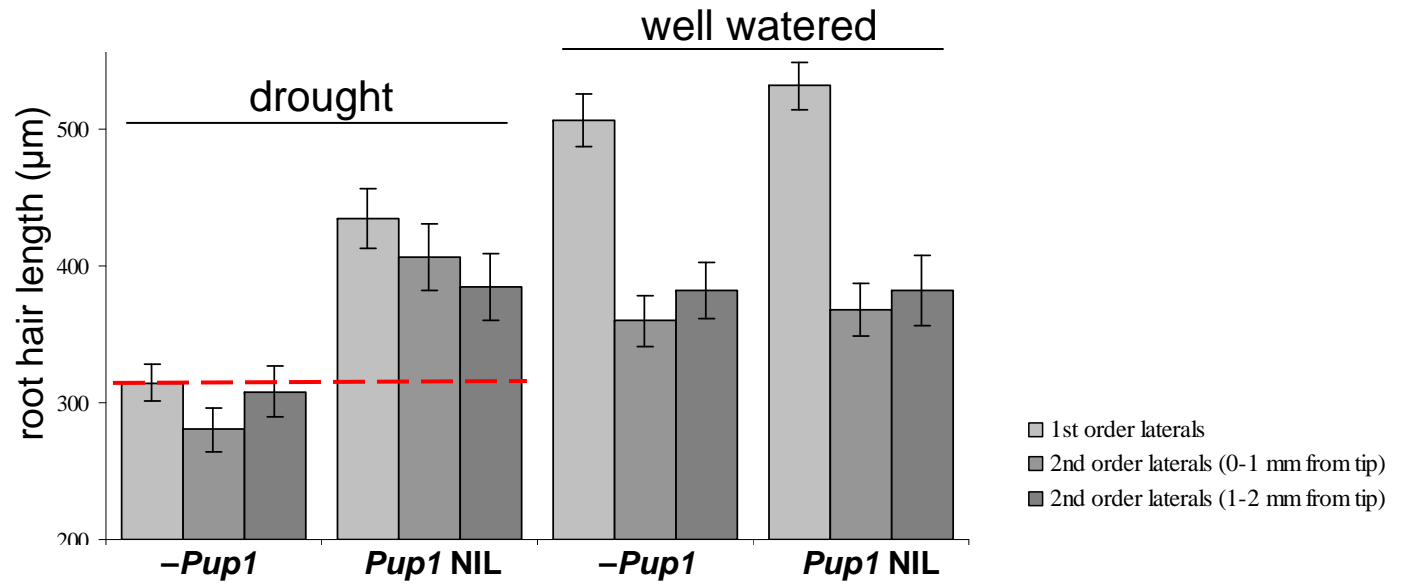
Root traits in *Pup1* NILs

1. Lignification of rice roots in response to drought and P-stress (dirigent gene)



2. *Pup1* NILs have longer root hairs under drought and P-stress

(plants 50 DAS grown in P-deficient soil)



The *Pup1* team:

Recent publications:

- Heuer et al (2009) *Plant Biotech J* 7:456–471
- Chin et al 2009, submitted to TAG
- Ismail et al (2007) *Plant Mol Biol* 65:547–570

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New PDF at JIRCAS:
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Lorie, Midie, Anthony

Rani,

Greg Howell

HJ Chin

Rico Gamuyao

and

- Stephan Haefele et al
- Arvind Kumar et al