

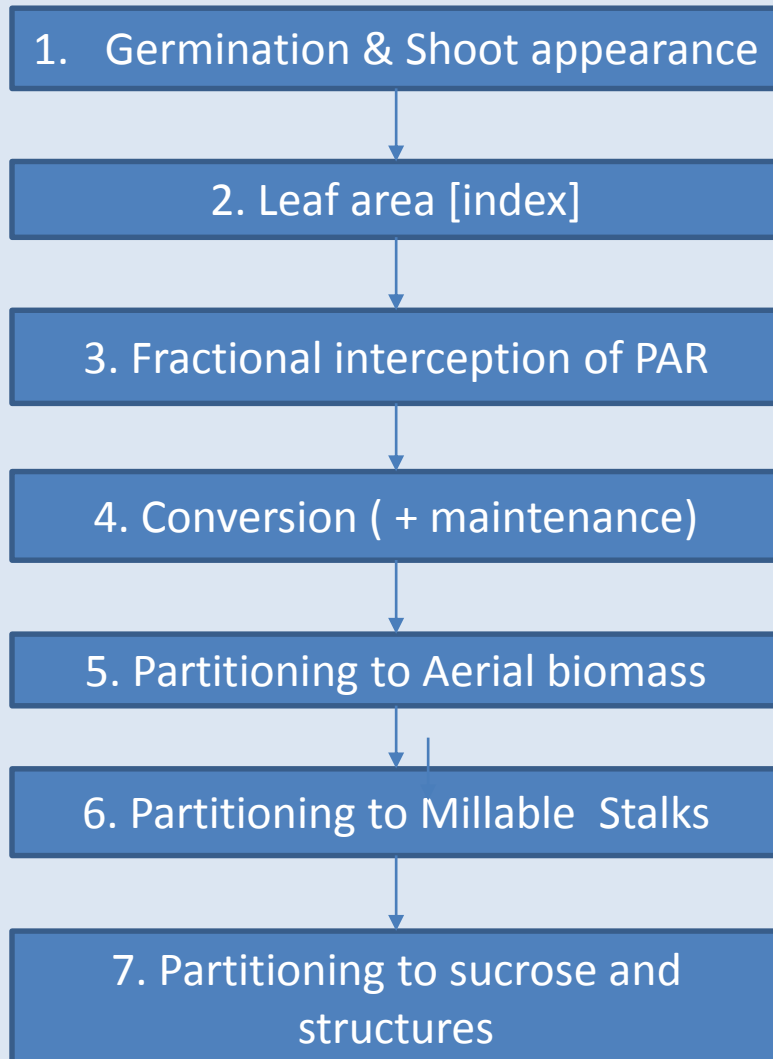
Simulating genotype performance with Mosaicas



Mathias Christina
June 26th 2017, Durban



Main processes & parameters calibrated within Mosaic



Visual calibration for shoot appearance

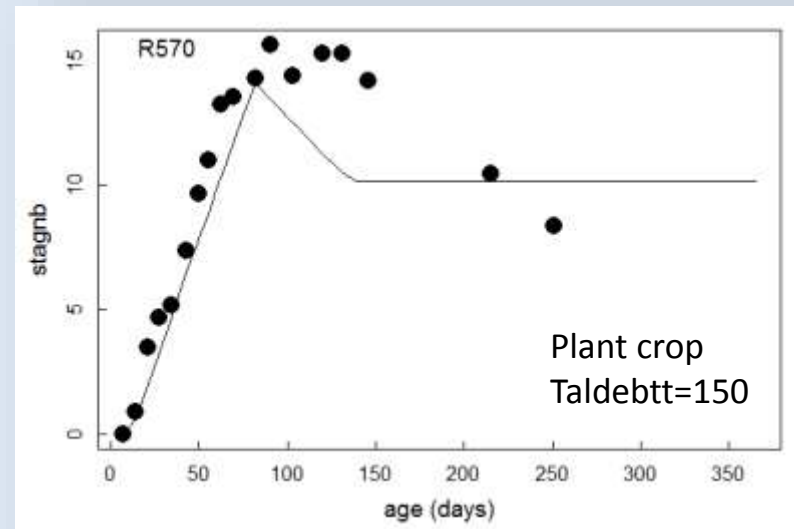
1. Germination & Shoot appearance

Observation

Stagnb: Number of alive stalks (/m²)

Parameter

Taldebtt: thermal time to reach appearance of first stalks



Sequential calibration (recuit method implemented in Mosaic)

1. Germination & Shoot appearance

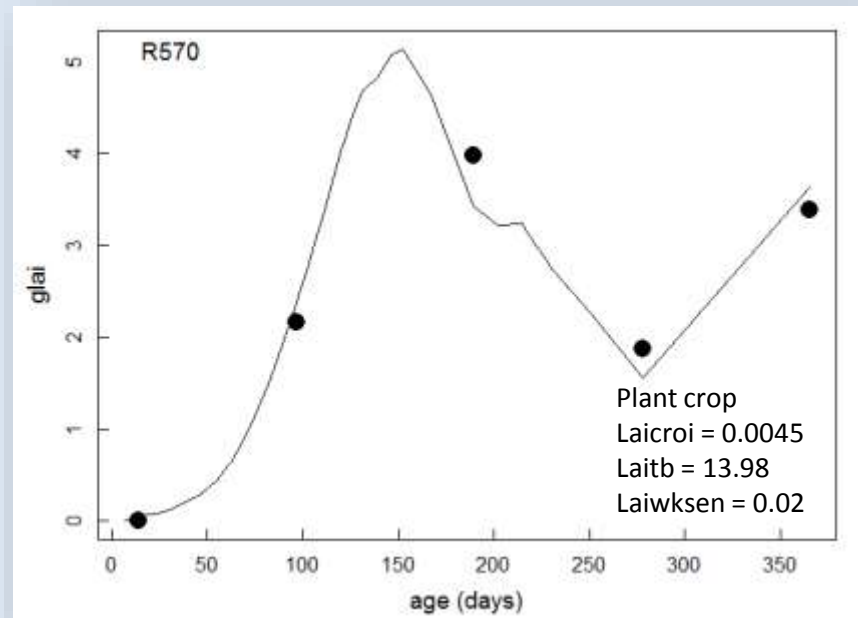
2. Leaf area [index]

Observationglai: green leaf area index (m^2/m^2)**Parameter**

Laicroi: growth rate of LAI

Laitb: base temperature for LAI calculation

Laiwksen: sensitivity to water stress



Sequential calibration (recruit method implemented in Mosaic)

1. Germination & Shoot appearance

2. Leaf area [index]

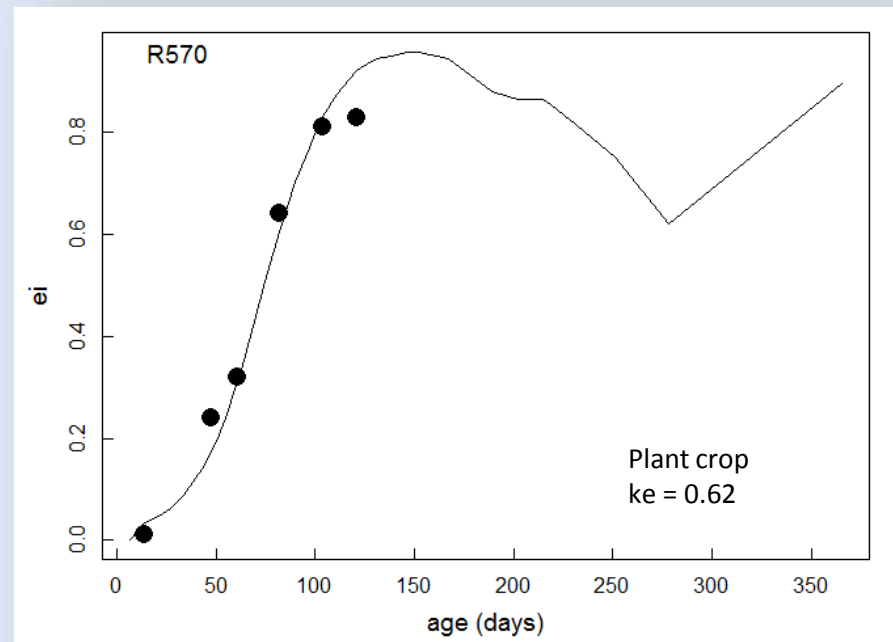
3. Fractional interception of PAR

Observation

e_i : interception efficiency (0-1)

Parameter

k_e : extinction coefficient



Sequential calibration (recruit method implemented in Mosaic)

1. Germination & Shoot appearance

2. Leaf area [index]

3. Fractional interception of PAR

4. Conversion (+ maintenance)

5. Partitioning to Aerial biomass

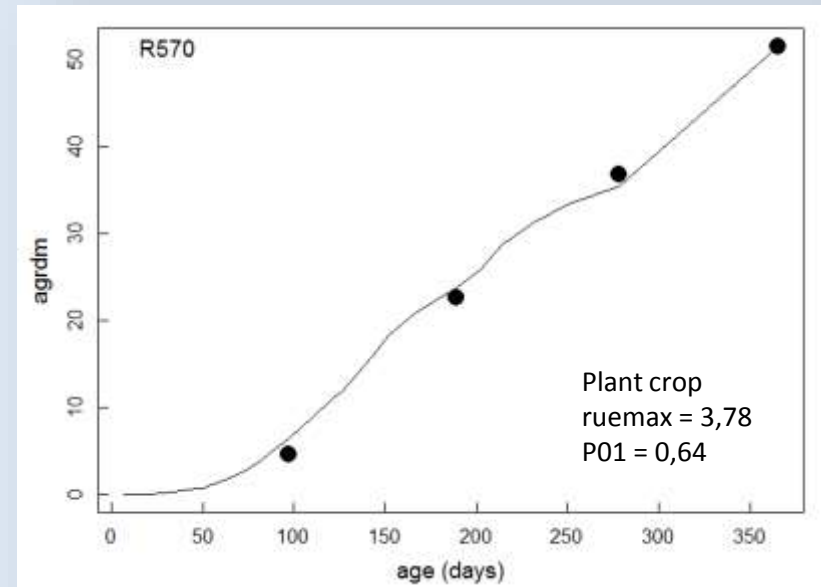
Observation

agr_{dm}: aboveground dry biomass including trash and dead stalks (T/ha)

Parameter

ru_{max}: conversion coefficient of intercepted photosynthetic radiation into total dry mass (g/M)

p₀₁: coefficient for maintenance effect on conversion



Sequential calibration (recruit method implemented in Mosaic)

1. Germination & Shoot appearance

2. Leaf area [index]

3. Fractional interception of PAR

4. Conversion (+ maintenance)

5. Partitioning to Aerial biomass

6. Partitioning to Millable Stalks

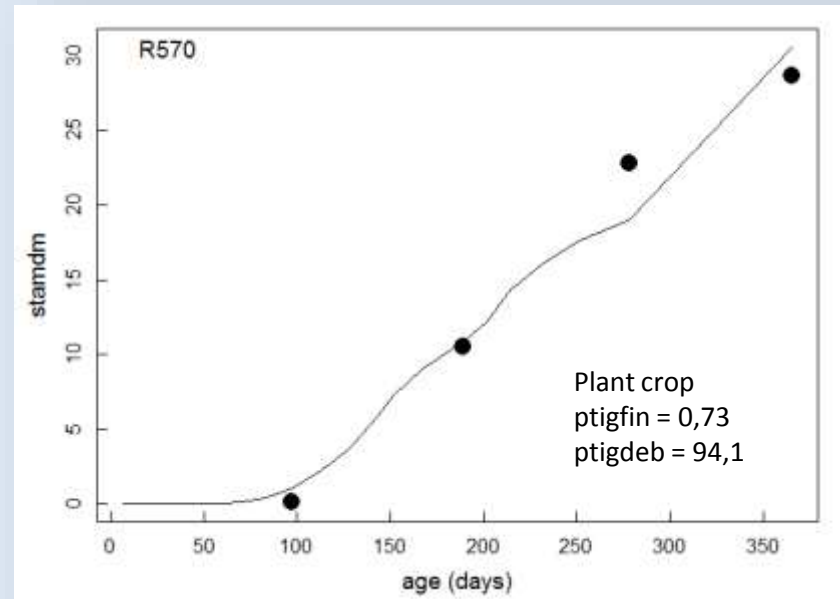
Observation

stamd_m: dry mass of millable stalks (T/ha)

Parameter

ptig_{fin}: final daily fraction of aboveground dry mass allocated to millable stalks

ptig_{deb}: beginning of millable stalk dry mass appearance (g/m²)



Sequential calibration (recuit method implemented in Mosaic)

1. Germination & Shoot appearance

2. Leaf area [index]

3. Fractional interception of PAR

4. Conversion (+ maintenance)

5. Partitioning to Aerial biomass

6. Partitioning to Millable Stalks

7. Partitioning to sucrose and structures

Observation

stamsu: sucrose production (T/ha)

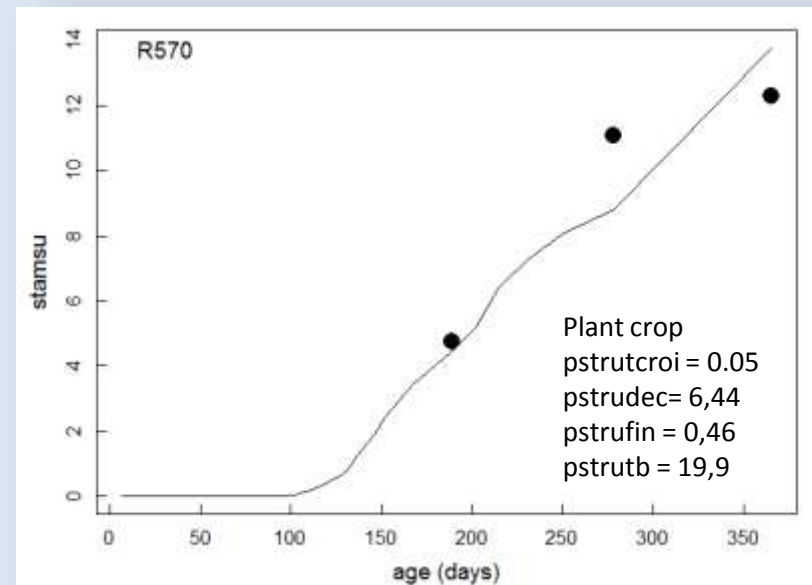
Parameter

pstrutcroi: T effect on fraction of stalks dry mass allocated to the structure ($^{\circ}\text{C}^{-1}$)

pstrudec: extinction coefficient of dry mass allocated to structures

pstrufin: final fraction allocated to structures

pstrutb: T threshold for decrease in dry mass allocated to structures



Dataset used for calibration

Calibration on each variety separately (13 parameters)

Dataset: Reunion island experiment + Pongola experiment

Calibration on both experiment:

R570

N41

CP881-762

Calibration on Reunion:

NCO376

Q183

Calibration on Pongola:

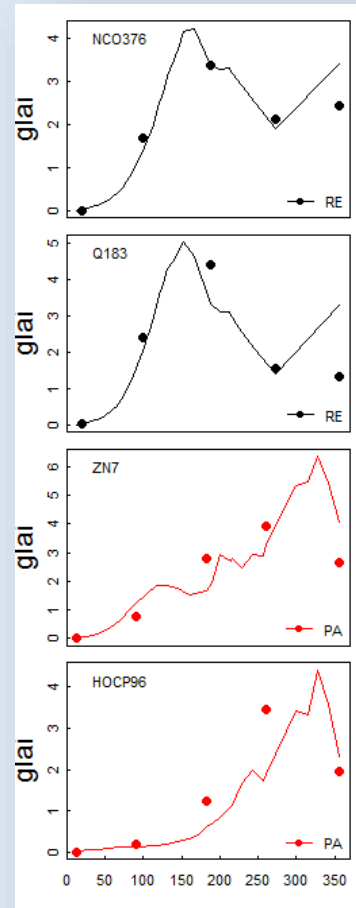
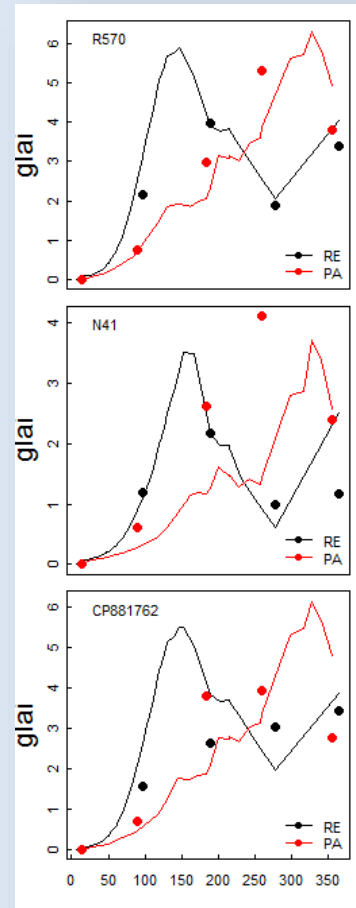
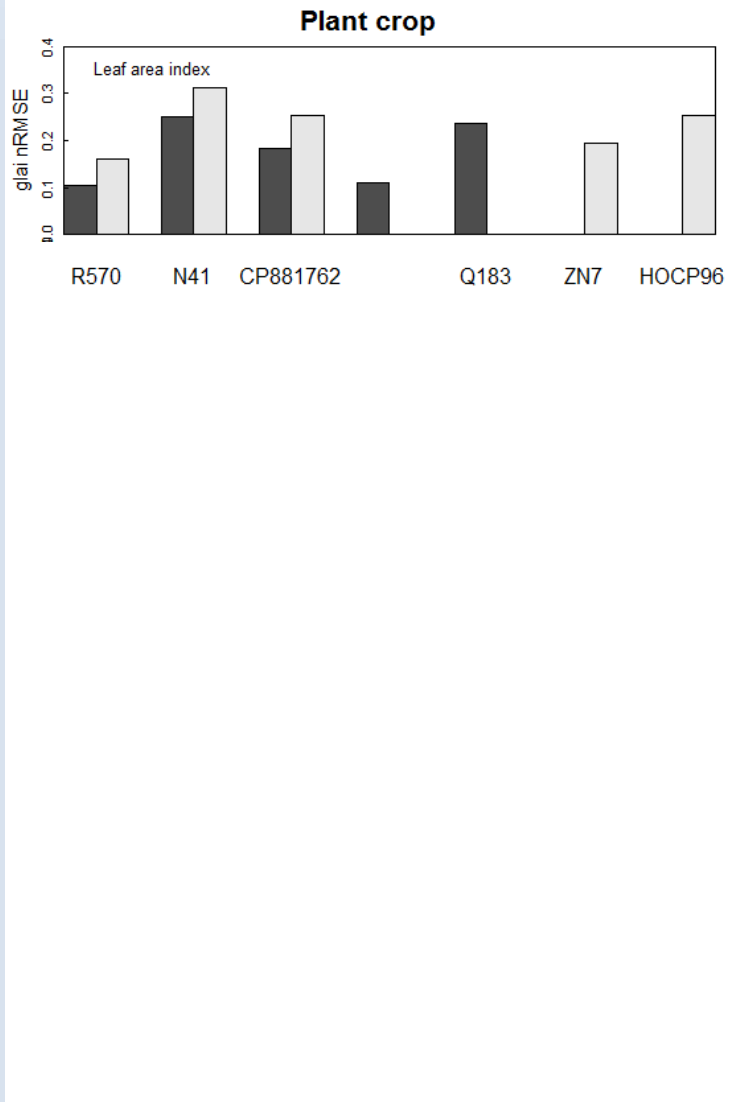
ZN7

HOCP96

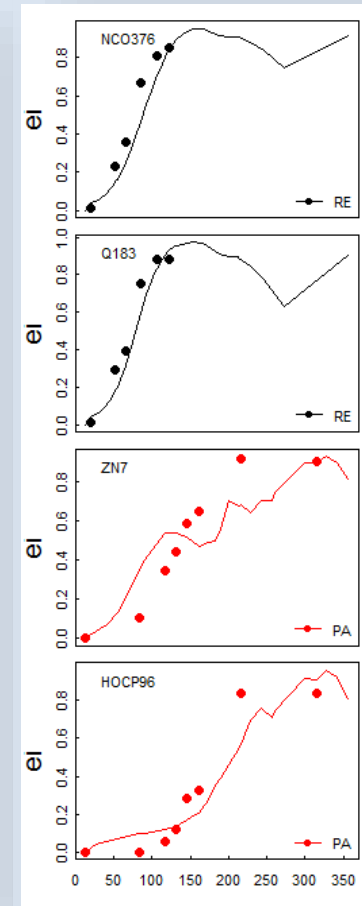
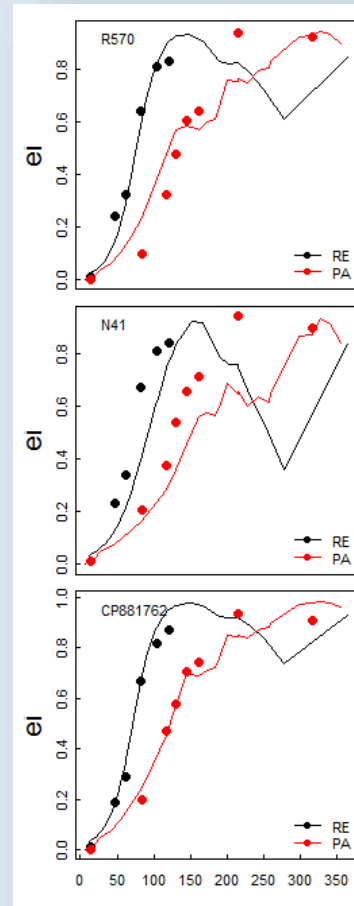
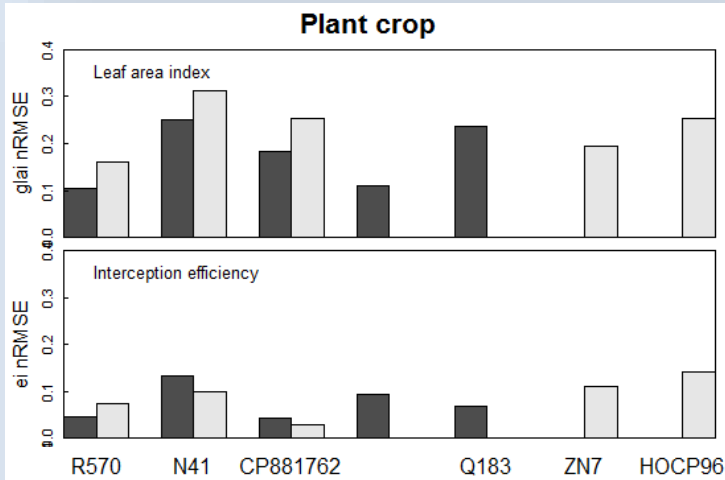
Plant crop

Ratoon crop

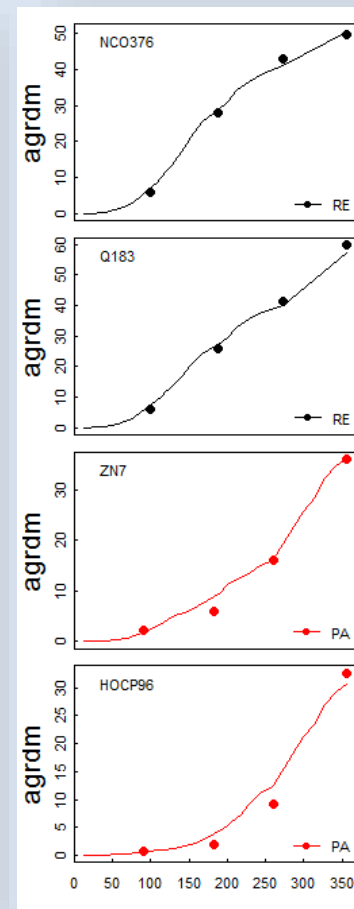
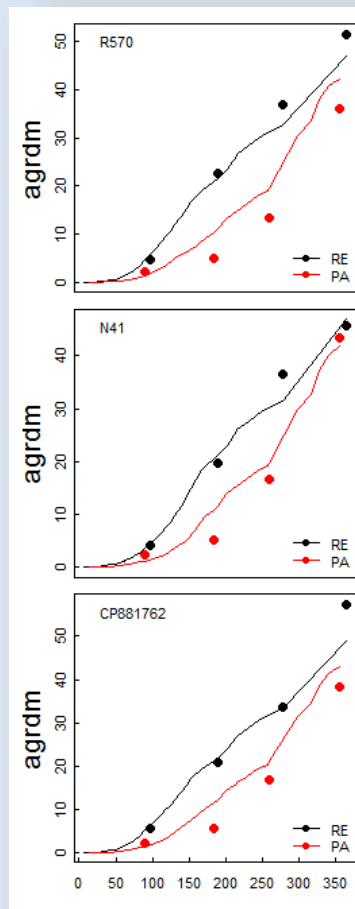
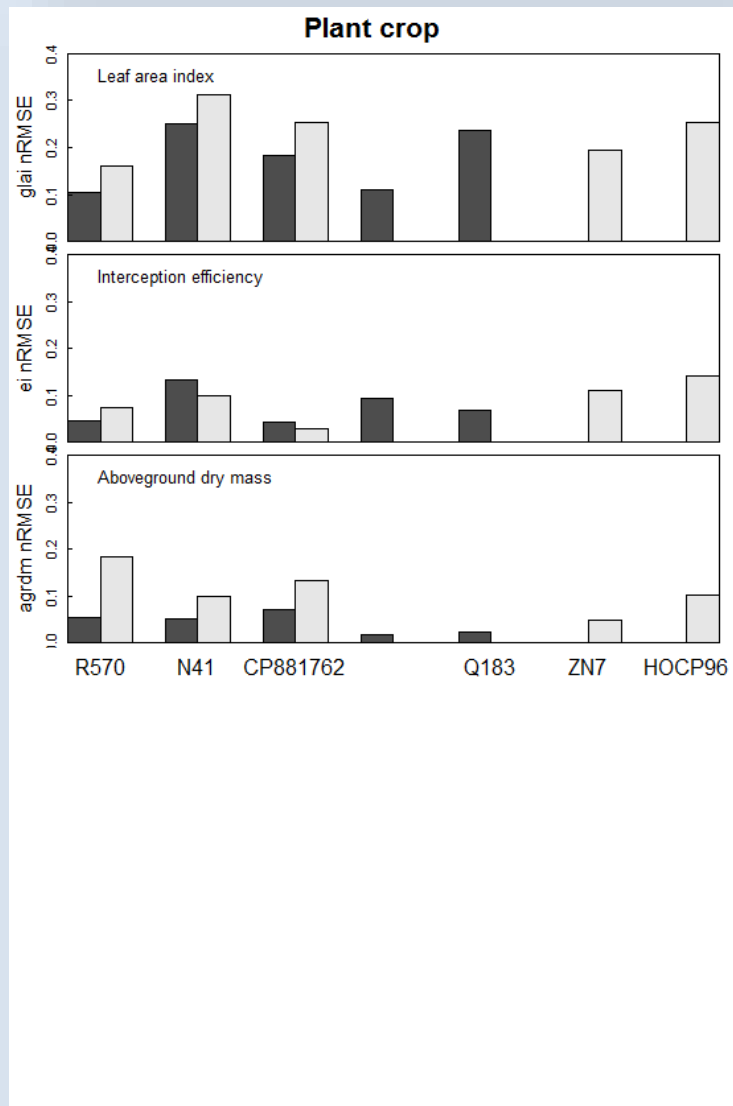
Calibrated model, **plant crop**



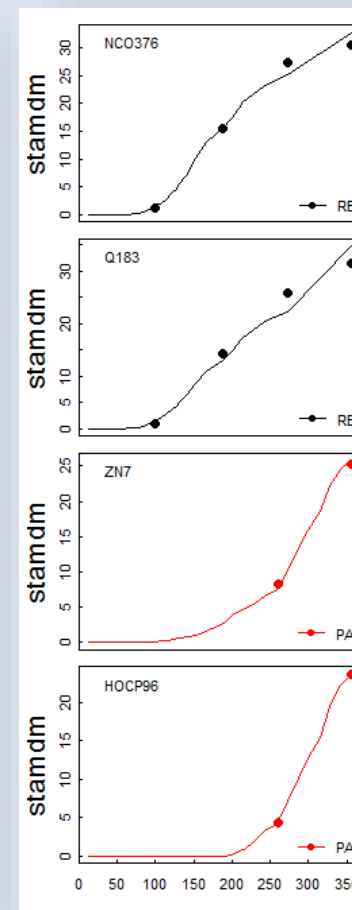
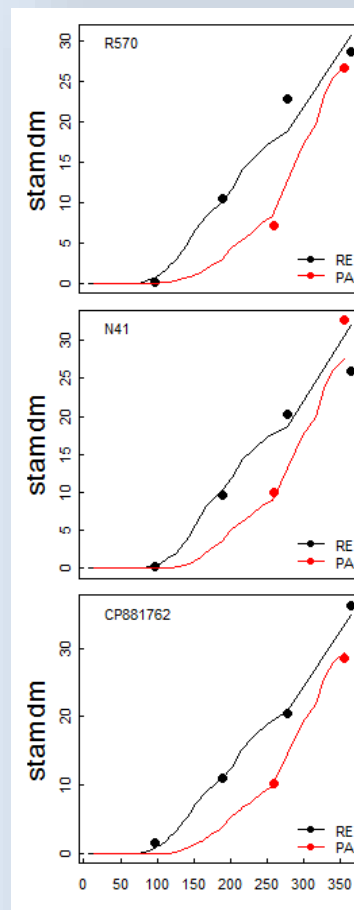
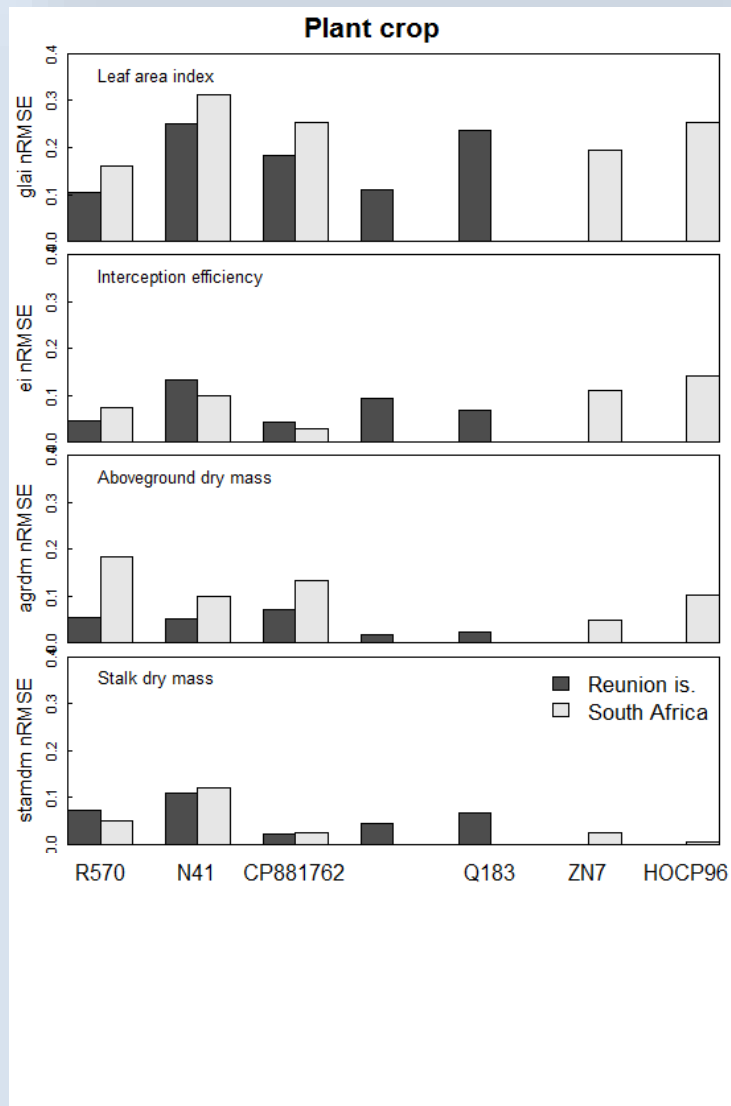
Calibrated model, plant crop



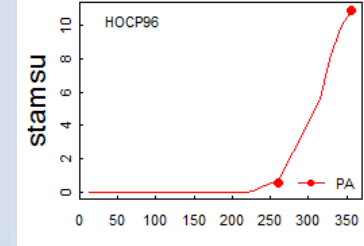
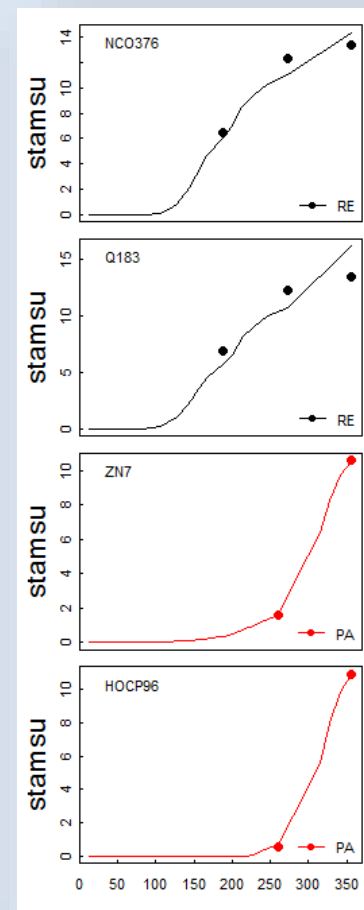
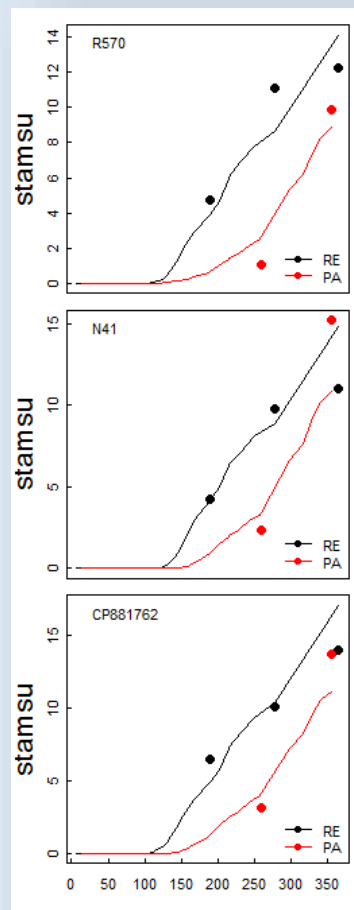
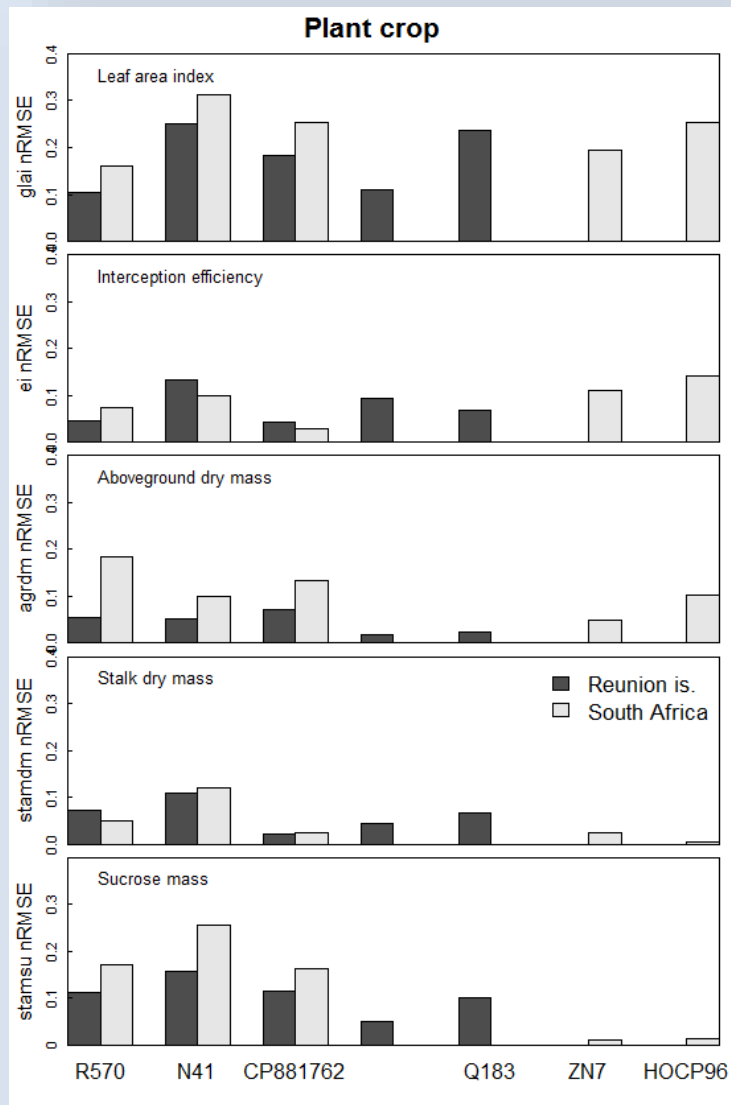
Calibrated model, plant crop



Calibrated model, plant crop



Calibrated model, plant crop



Conclusion: Plant crop

Genotype effect: weak discrepancy among cultivars

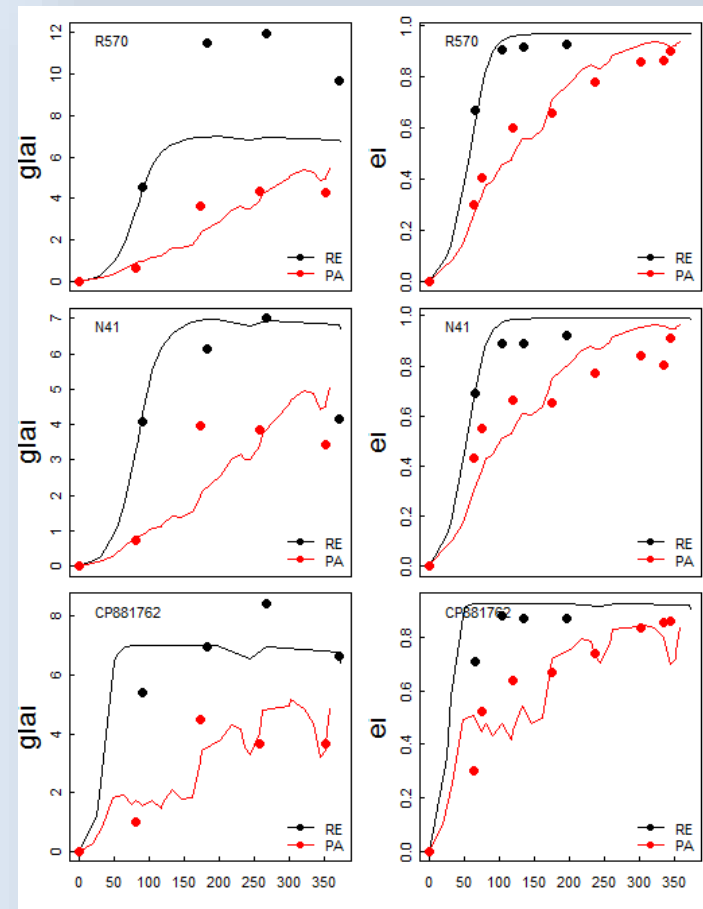
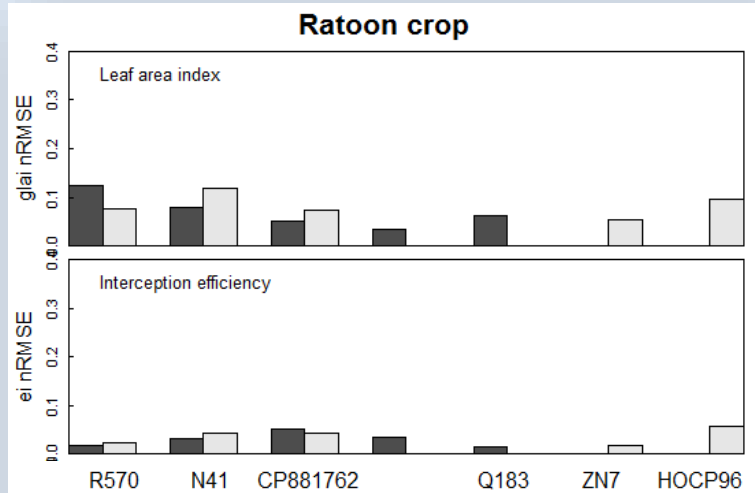


Environment effect: good simulations in both countries

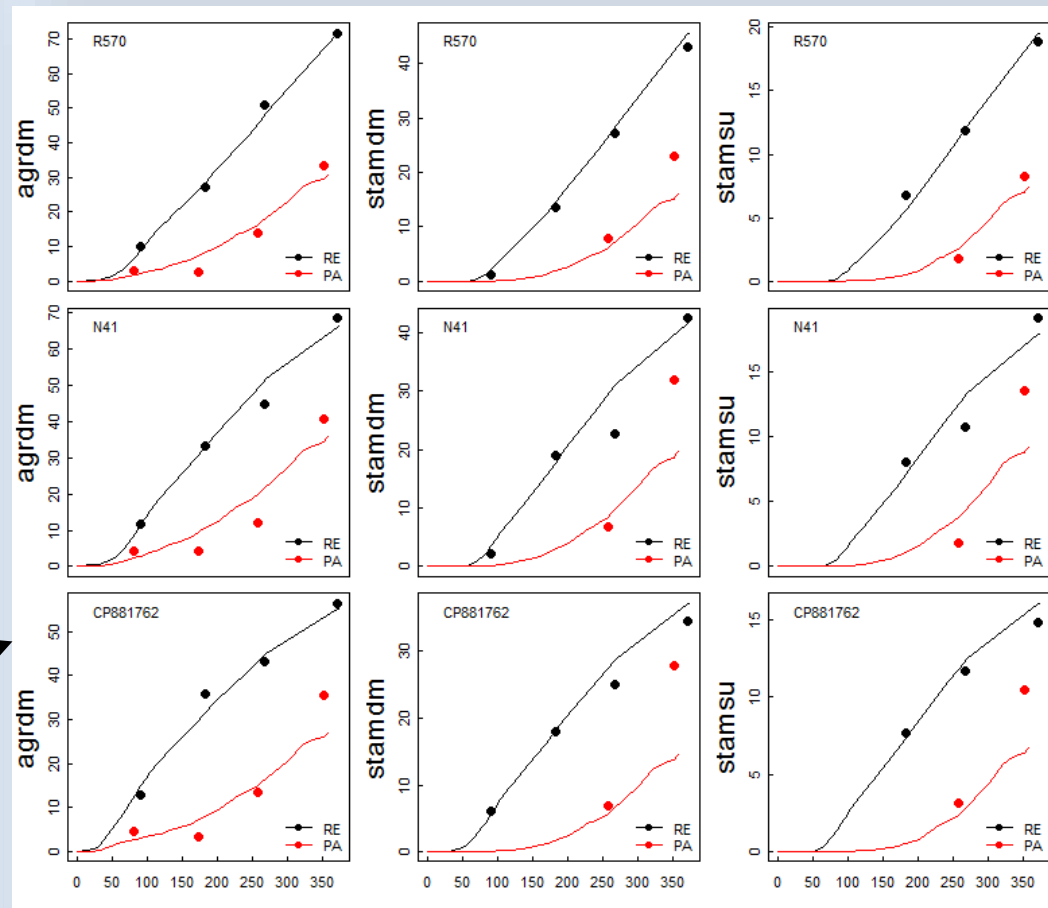
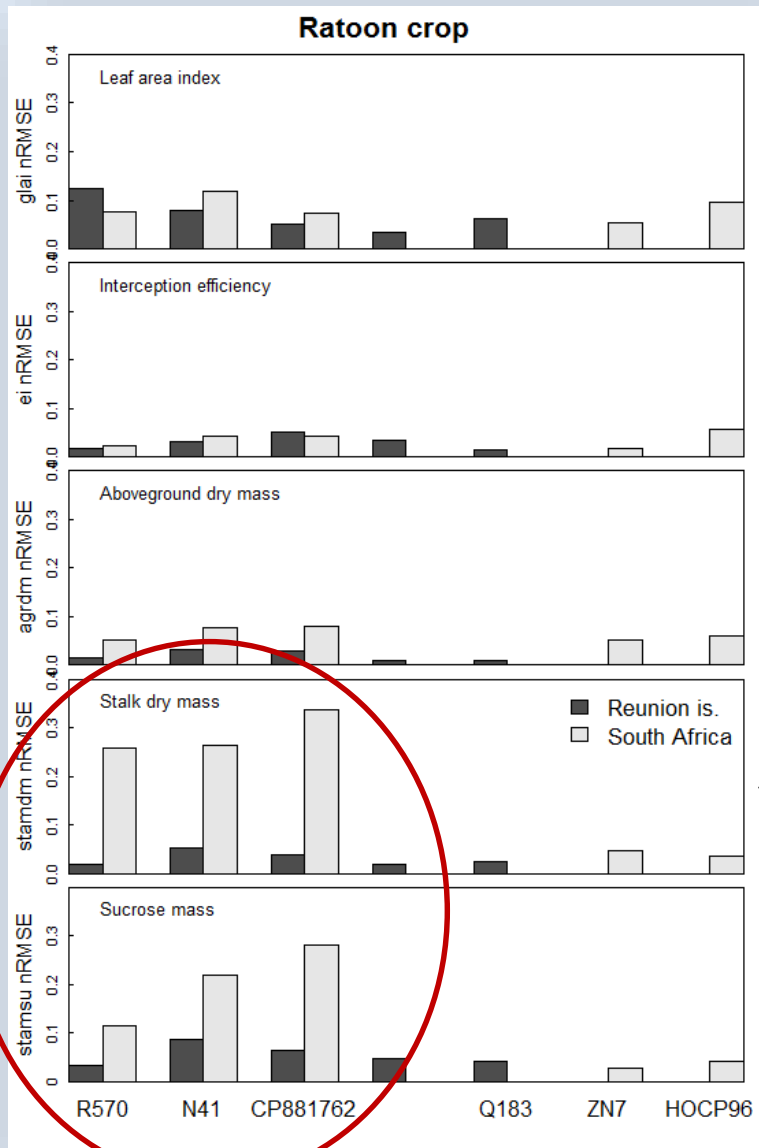
- LAI and interception dynamics
- Dry mass and sucrose production

Even if a slight over-estimation of aboveground dry mass production in South Africa

Calibrated model, **ratoon crop**




Calibrated model, ratoon crop



Conclusion: ratoon crop

Genotype effect: weak discrepancy among cultivars



LAI dynamic is not well simulated
(threshold effect within the Mosaic model)

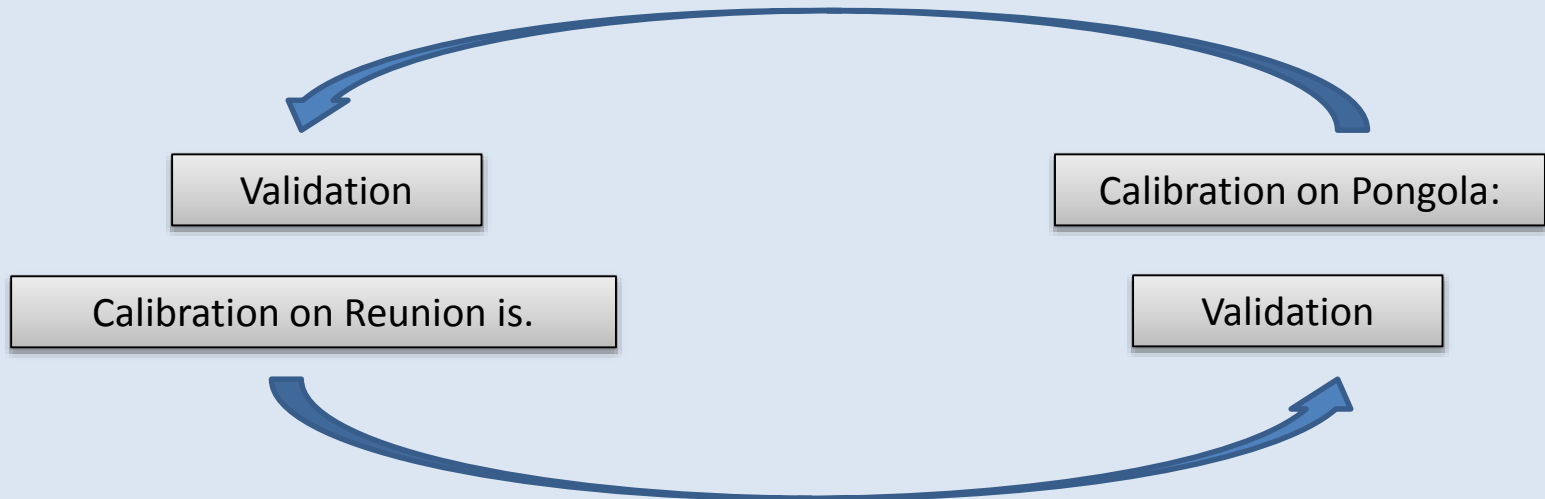


Environment effect:

- good simulations in Reunion island
- underestimation of stalk mass and sucrose production in South Africa

Fertilization effect ?

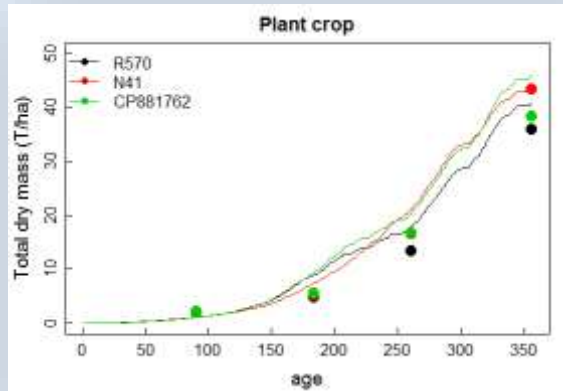
Model validation: 3 varieties R570, N41 & CP881-762



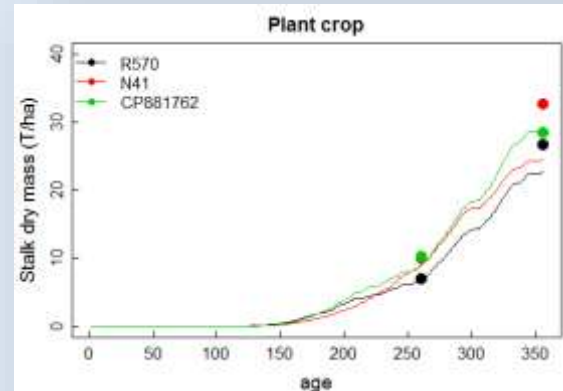
Calibration on Pongola:

Calibration on Reunion is.

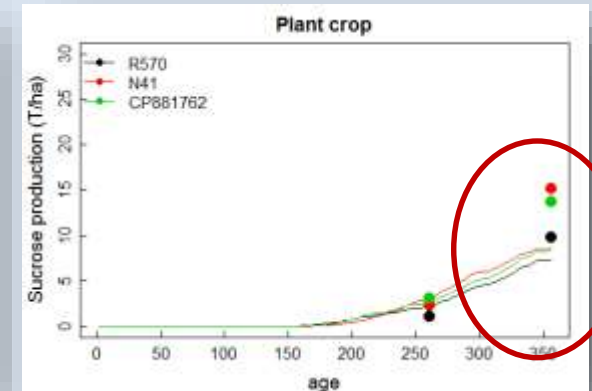
Validation



Total dry mass



Stalk dry mass



Sucrose production

The model represent accurately the environment effect on dry mass production at **crop plant** level

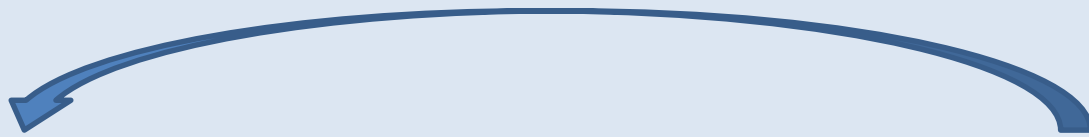
Less for final sucrose production...

Process

Calibration

Validation

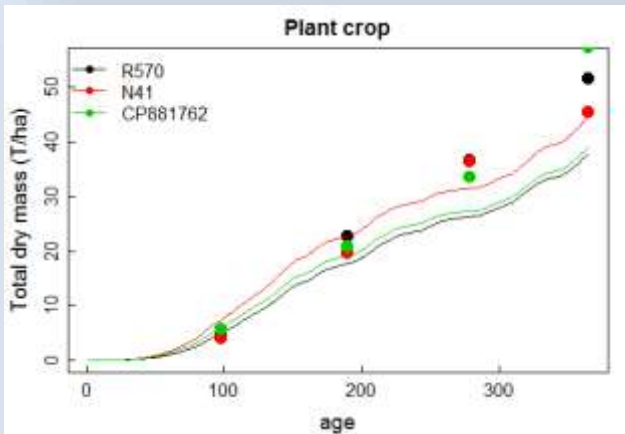
conclusion



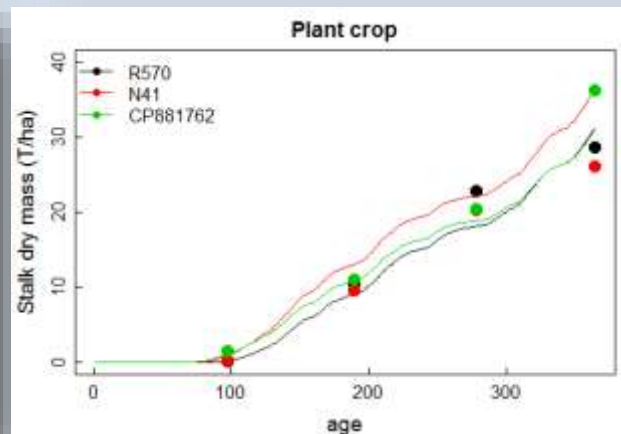
Validation

Calibration on Pongola:

Calibration on Reunion is.

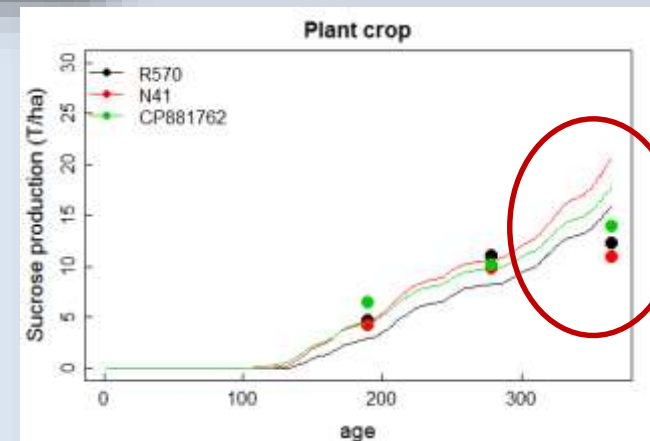


Total dry mass



Stalk dry mass

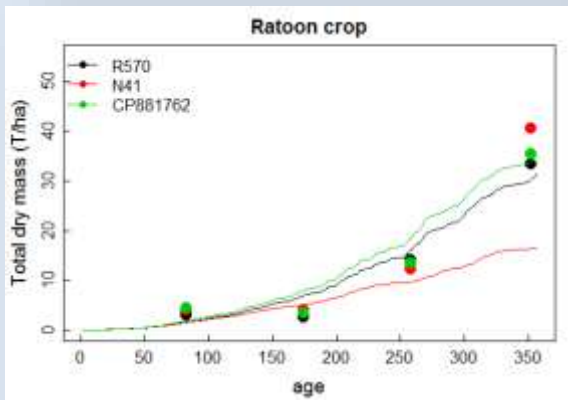
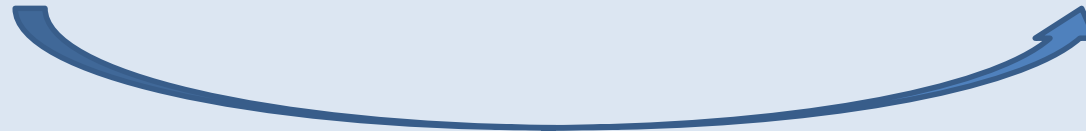
Sucrose production



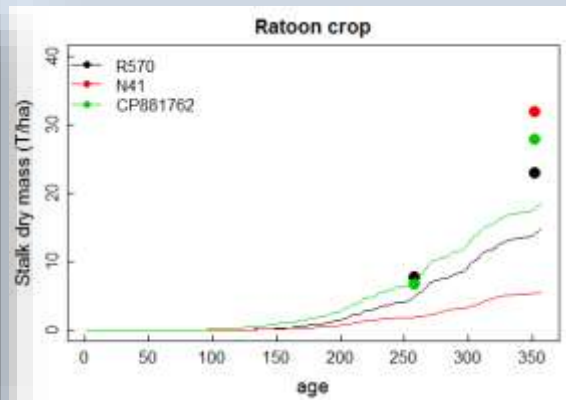
Calibration on Pongola:

Calibration on Reunion is.

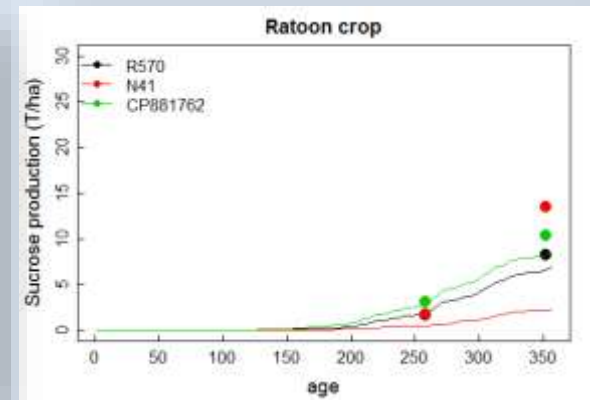
Validation



Total dry mass



Stalk dry mass



Sucrose production



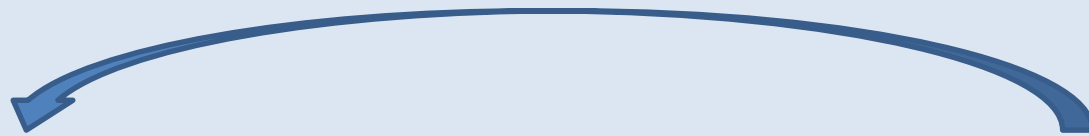
The model doesn't represent accurately the environment effect on dry mass production at **ratoon plant** level

Process

Calibration

Validation

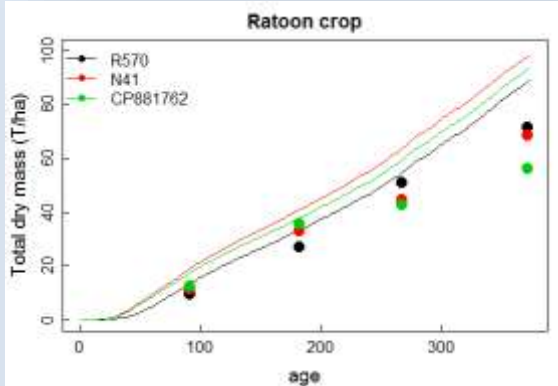
conclusion



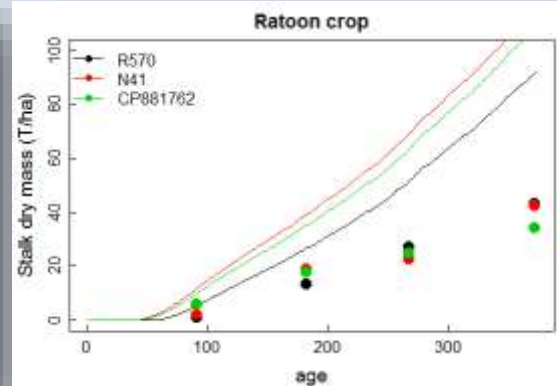
Validation

Calibration on Pongola:

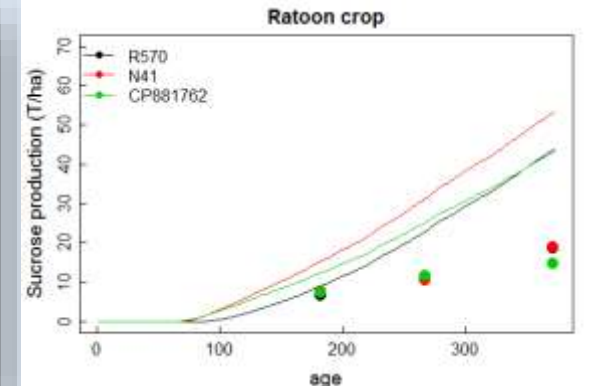
Calibration on Reunion is.



Total dry mass



Stalk dry mass



Sucrose production



An effect (different in Reunion and South Africa) controlling dry mass and sucrose production at the ratoon plant level is not taking into account within the Mosicas model...

Fertilization ?

CCL & Perspective:

- Mosicas model simulate accurately the GxE effect on plant crop but perhaps less on ratoon crop
 - to confirm with simulations on Zimbabwe & USA experiment
- Mosicas performance: test on other calibration methods, or additional parameters (ex. effect of water stress on RUE)
- Model comparison: necessity on a common calibration method for each model

Thanks !

Ratoon

Parameter	R570	N41	CP881762	NCO376	Q183	ZN7	HOCP96
taldebtt	150	150	160	150	150	150	200
laicroi	0,00320837	0,00229224	0,00336586	0,00262638	0,00321397	0,00500283	0,00543687
laitb	7,34877949	8,5745636	9,51800038	9,43594654	10,33604931	9,77950007	16,37320576
laiwksen	0,01868568	0,03081969	0,01835962	0,01572732	0,0220782	0,03265618	0,04599223
ke	0,45424905	0,71977023	0,67984791	0,71977023	0,71977023	0,41640047	0,71977023
ruemax	3,65109255	3,87688597	3,33528136	5,03277982	4,20456311	3,28569053	3,00351283
p01	0,2888905	0,57267129	0,13308821	1,59493359	0,85695376	0,3300463	0,99600485
ptigfin	0,83747705	0,86349283	0,90707649	0,79639039	0,72670945	0,98875825	1,25163057
ptigdeb	174,93027296	143,6848259	200,02672389	94,2001915	94,12998792	156,59564776	344,48000788
pstrucroi	0,05150039	0,04219087	0,05200107	0,04798024	0,05112921	0,01941434	0,02865078
pstrudec	3,17755318	5,05848177	8,00051785	5,51605988	6,39615774	1,07422972	1,01348734
pstrufin	0,45470527	0,56521349	0,56222276	0,45067882	0,43701548	0,67282968	0,76105842
pstrutb	20,81027613	15,88002603	15,93648434	19,38015103	21,56328721	16,81688447	22,88512208

Plant

Parameter	R570	N41	CP881762	NCO376	Q183	ZN7	HOCP96
taldebtt	150	150	160	150	150	150	200
laicroi	0,00320837	0,00229224	0,00336586	0,00262638	0,00321397	0,00500283	0,00543687
laitb	7,34877949	8,5745636	9,51800038	9,43594654	10,33604931	9,77950007	16,37320576
laiwksen	0,01868568	0,03081969	0,01835962	0,01572732	0,0220782	0,03265618	0,04599223
ke	0,45424905	0,71977023	0,67984791	0,71977023	0,71977023	0,41640047	0,71977023
ruemax	3,65109255	3,87688597	3,33528136	5,03277982	4,20456311	3,28569053	3,00351283
p01	0,2888905	0,57267129	0,13308821	1,59493359	0,85695376	0,3300463	0,99600485
ptigfin	0,83747705	0,86349283	0,90707649	0,79639039	0,72670945	0,98875825	1,25163057
ptigdeb	174,93027296	143,6848259	200,02672389	94,2001915	94,12998792	156,59564776	344,48000788
pstrucroi	0,05150039	0,04219087	0,05200107	0,04798024	0,05112921	0,01941434	0,02865078
pstrudec	3,17755318	5,05848177	8,00051785	5,51605988	6,39615774	1,07422972	1,01348734
pstrufin	0,45470527	0,56521349	0,56222276	0,45067882	0,43701548	0,67282968	0,76105842
pstrutb	20,81027613	15,88002603	15,93648434	19,38015103	21,56328721	16,81688447	22,88512208