

## Fast-track breeding of high-yielding varieties of *Artemisia annua*

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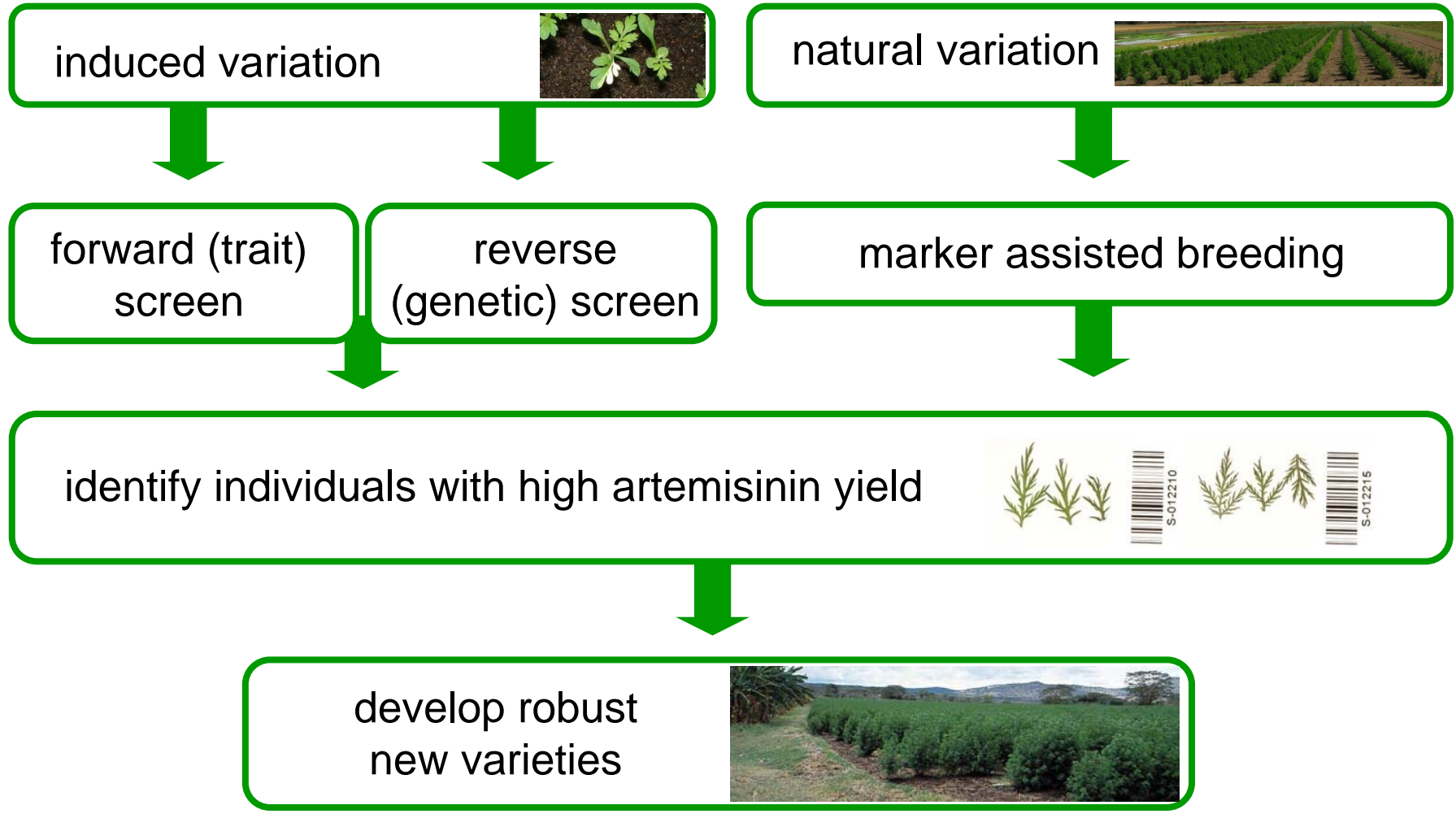
## Aims of the CNAP Artemisia Research Project

- to identify plants of *A. annua* with increased yields of artemisinin.
- to field trial plants, confirm heritability of high yield trait and select the best lines
- to develop robust and stable high yield varieties which will slot into the current supply chain for ACTs
- to deliver high-yielding seed to the ACT supply chain in as short a timeframe as possible
- to reduce the cost of ACTs





# Scientific strategy





## Starting material

- Artemis - developed by Mediplant and currently used commercially. Yielding from 0.6 to 1.2% depending on the location
- collection of other varieties from various locations including Vietnam and East Africa



## Summary of Breeding Routes

Route 1: Forward Screen

Route 2: Natural variation from the Artemis gene pool

Route 3: QTL analysis of Artemis

Route 4: Use of natural populations

Route 5: Association study of natural variation

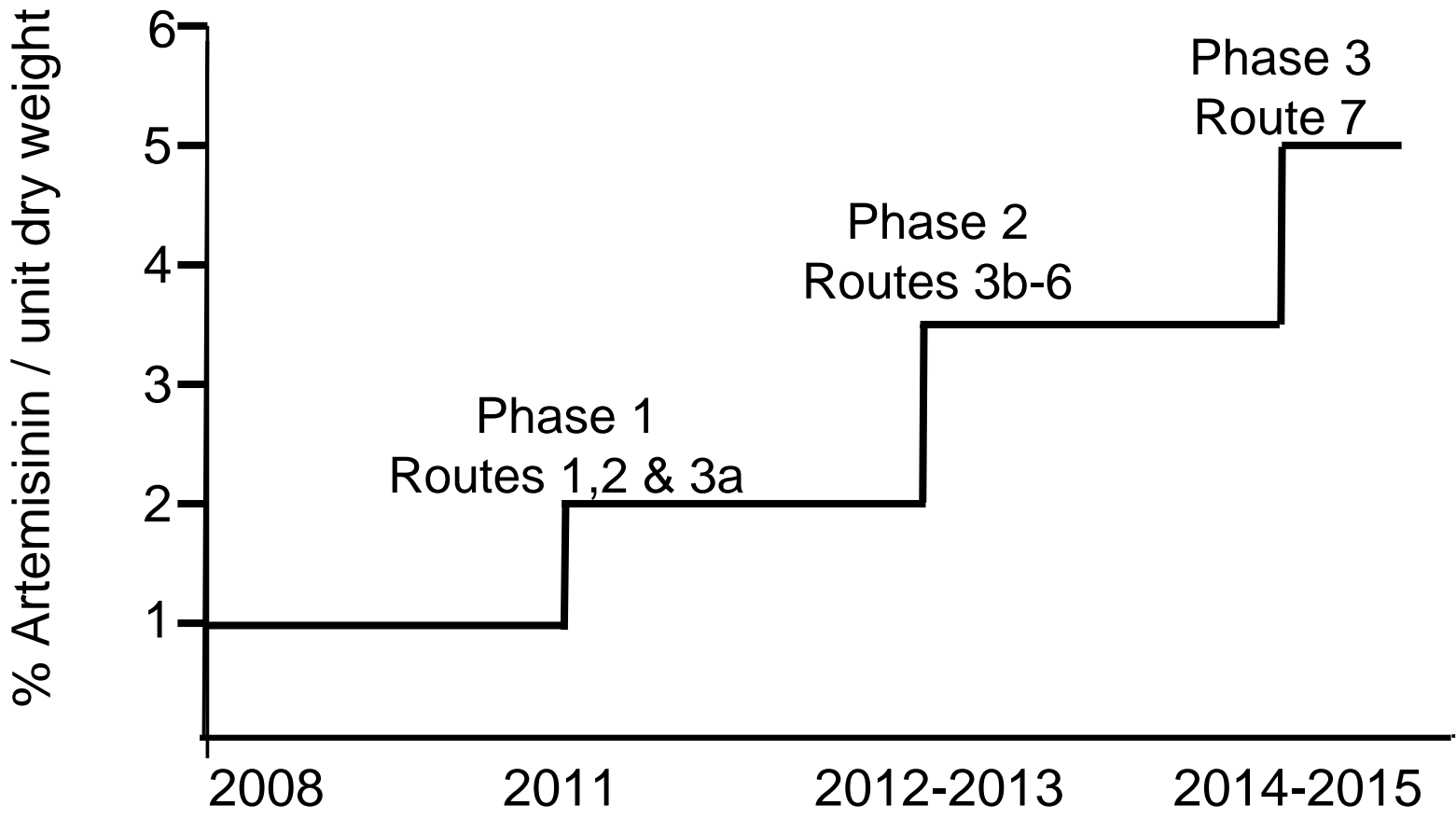
Route 6: Heteroduplex mapping

Route 7: Combining traits

Induced variation  
Natural variation

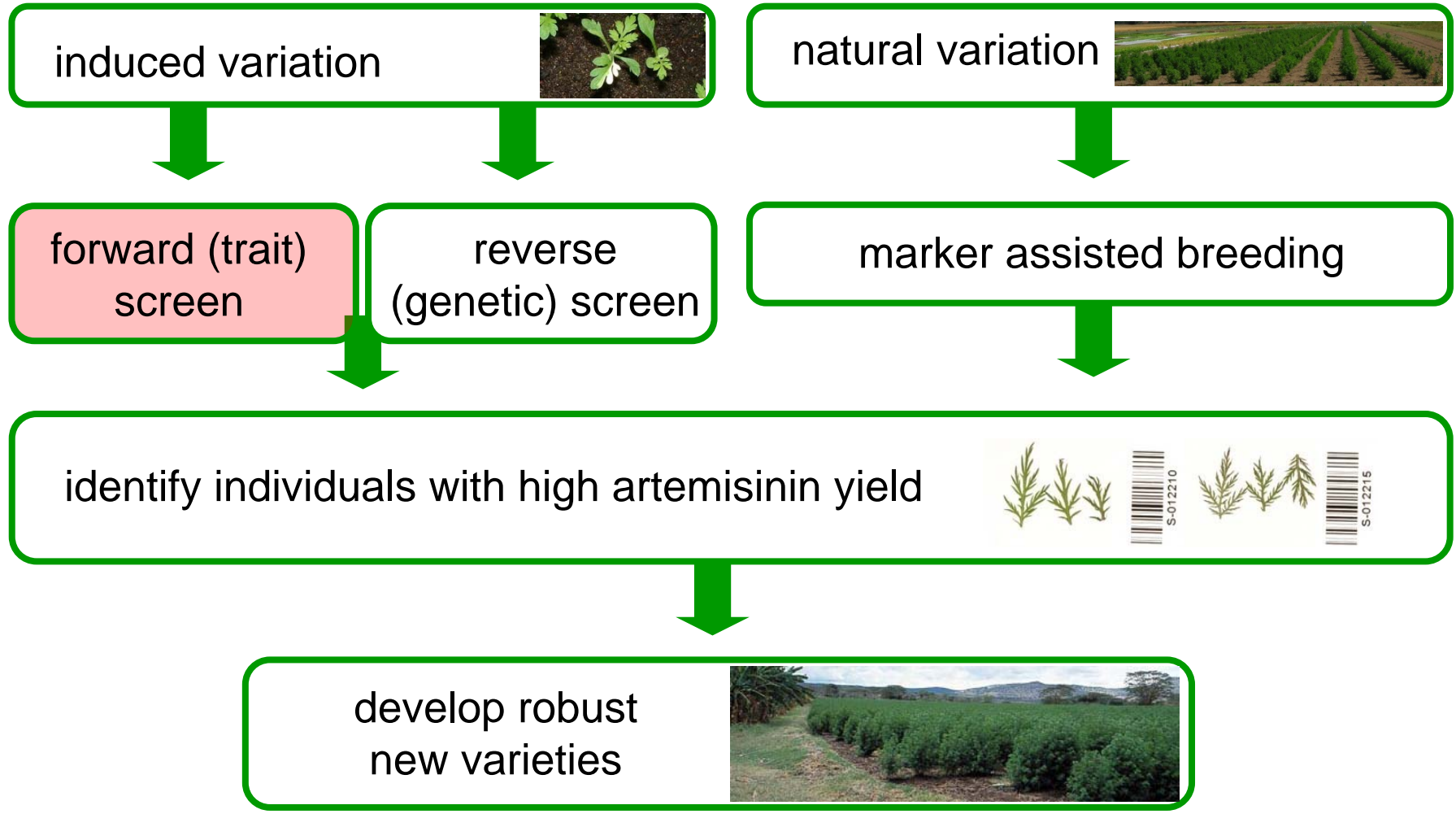


# Delivery timeline



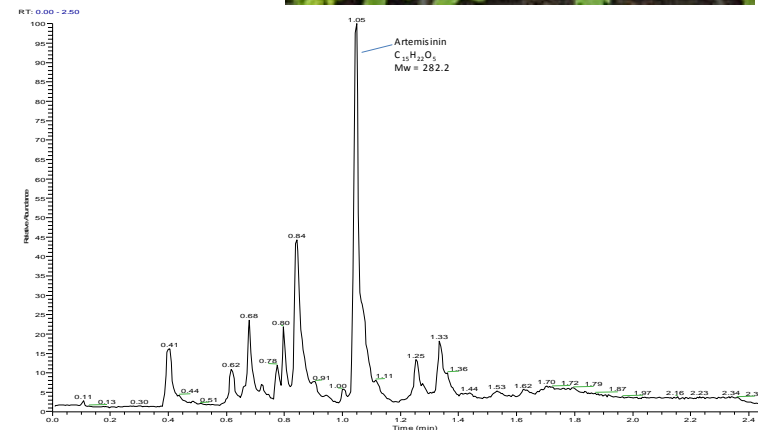


# Scientific strategy



## Route 1: Forward (trait) Screen

- high throughput screen of M2 (selfed) plants for artemisinin yield
  - Chloroform dip
  - UPLC MS with 2.5 min run time
- identify high yielding individuals and confirm trait in the field
- ~1000 plants screened every two / three weeks.



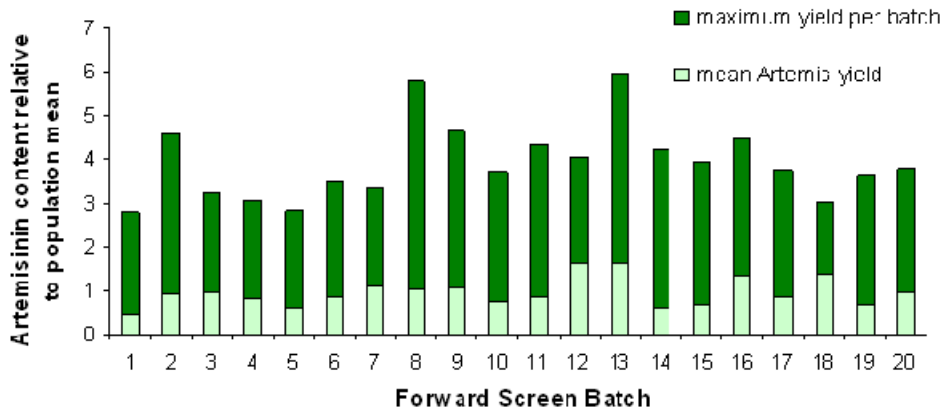




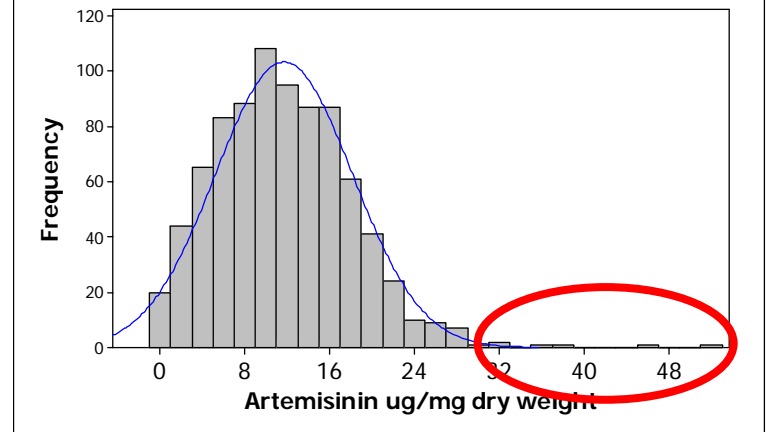
# Forward Screen Update

- **screened 21 000 / 25 000 plants**
- **identified 230 high yield** individuals (between 1.5 and 3 fold higher than Artemis)

**Artemisinin Yield of Highest Yielding Plants per Forward Screen Batch**

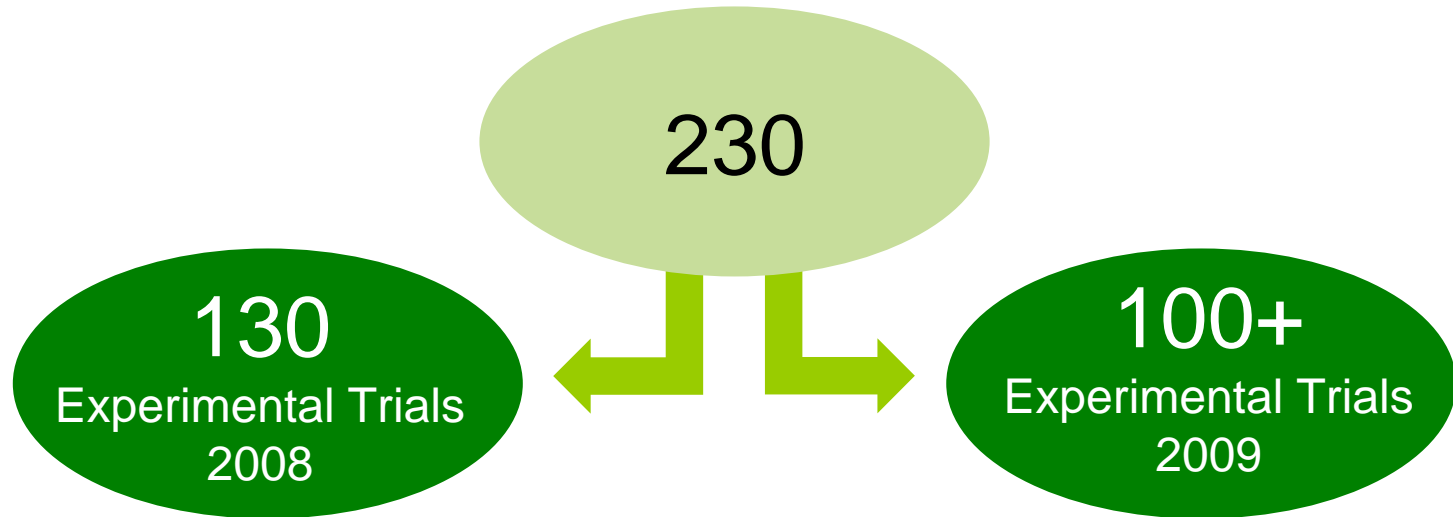


**Distribution of Forward screen Batch 9**





## Forward Screen Status



- experimental trials will characterise
    - metabolite content
    - trichome density
    - biomass traits (height, fresh weight, leaf area, nodes)
    - vegetative stage
    - plant architecture
- to determine field performance and establish basis of high yield trait



## Project status

- multiple lines exhibiting increased yield in artemisinin identified using a forward screen.
- first heritability data suggests a significant proportion of these are due to genotype
- mapping populations established in 3 different environments and genetic map constructed.
- mutations in target genes identified with potential to increase yield of artemisinin

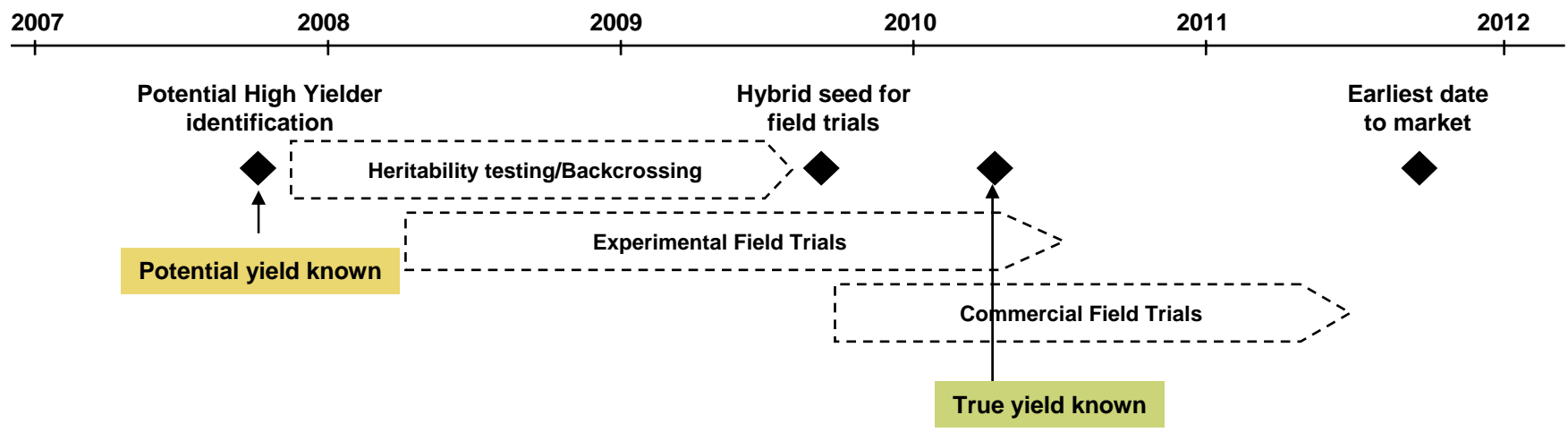




# EARLIEST DELIVERY - 2011

Minimum target yield improvement is double the yield of Artemis

Potential yield improvement from Phase 1 routes already known ~ 2-4% artemisinin per unit dry weight





## Acknowledgements – Artemisia Research Project



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