



# Status of Marker-Assisted Selection Technologies in Legumes

- cowpea, groundnut, pigeonpea, chickpea and lentil -

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# MARKER-ASSISTED SELECTION (MAS)

## **Breeder's perspective:**

- Shorter time to bring new varieties to market
- Avoid genotype-environment interaction
- Efficient and effective crop trait selection

# Cowpea (*Vigna unguiculata*)

## Major Constraints



# WHERE ARE WE? - COWPEA

## Genetic maps and markers:

### - Most current map: Quedraogo *et al.*, 2002 (*Genome* 45:175-188)

11 linkage groups (LGs)

2670 cM total genetic distance

Approx. 6 cM between markers

### - Markers mapped

Morphological (seed weight, earliness, pod colour)

Biochemical (chilling, virus, nematodes)

Molecular (262 AFLP; 133 RAPD; 39 RFLP; 18 RGAs etc.)

432 assigned to a LG

# WHERE ARE WE? - COWPEA MAS

## More molecular markers:

### 2 SCAR and a number of 48 AFLP markers

Linked to the *Striga gesnerioides* resistance genes for races 1 and 3

SCAR 61R - most reliable predictor for races 1 and 3 (LG1)

SEACTMCAC83/85 - Bourkar *et al.* (2004) race 1 (LG1)

### SSRs (Lin *et al.*, 2001)

- SSRs for *Striga* resistance
- SSRs for drought tolerance

# COWPEA MARKER ASSISTED SELECTION

Marker assisted selection for *Striga* resistance in cowpea:

Generation Challenge Program

January 2005 - December 2007

IITA (Nigeria); UVA (USA) and CERAAS (Senegal)



# GCP PROJECT - COWPEA MAS

- Marker development and conversion
  - *Striga* resistance genes for different *Striga* races in cowpea
  - Identification of *Striga* races in the field
  - Drought tolerance genes/QTLs
- Population development and characterisation
- Testing of existing *Striga* resistance markers using different genetic backgrounds
- Capacity building ...

# WHERE ARE WE? - COWPEA MAS

## **Marker-Assisted Selection: *Striga* resistance**

The 2 SCAR markers for *Striga* resistance being tested across a range of genetic backgrounds

A number of advanced genetic populations will be available ...

## **Marker-Assisted Selection: drought tolerance**

A number of advanced genetic populations available ...

Marker development and screening underway

More support required ...

# WHAT NEXT? - COWPEA MAS

## Develop and characterise advanced populations

Multiple traits: biotic and abiotic stresses

Better germplasm assessment and documentation

## Marker-Assisted Selection

Map saturation ...

... more markers ...

multiple traits? Cowpea bacterial blight, Bruchid, drought tolerance

Test efficacy of SCAR marker(s) and proceed to implement MAS: technical protocols *etc* required

Capacity building ...

# WHERE ARE WE? – GROUNDNUT (*Arachis hypogaea*)

## Genetic maps and markers:

- Most current map - AA genome: Moretzsohn *et al.*, 2005

11 linkage groups (LGs)

1,230.89 cM total map distance

Approx. 7 cM between markers

- Markers mapped

RAPD, SCAR and RFLP markers (root-knot nematode resistance genes)

AFLP markers (aphid vector of g`nut rosette disease)

SSR markers: 170 in total (61 likely to represent genes)

# WHERE ARE WE? - GROUNDNUT

## **Current activities:**

- BB genome map
- Exploitation of disease resistance genes

# WHERE ARE WE? – CHICKPEA (*Cicer arietinum* L.)

## Genetic maps and markers:

- **Most current map** - Cobos *et al.*, 2005 (TAG:110:1347-1353)

10 linkage groups (LGs)

427.9 cM total map distance

- **Markers**

Over 250 SSR from different genetic background

13 STMS and 118 RAPDs

## WHERE ARE WE? - CHICKPEA

- Two RAPD markers for two QTLs conferring Ascochyta blight (AB) resistance (Santra *et al.*, 2000)
- One RAPD marker (OPAC04/1200) linked to a major QTL for resistance to AB (Millan *et al.*, 2003)
- Fusarium wilt (FW) race 3 controlled by single gene (foc-3) linked to SSR markers TA96 and TA27 and STMS marker CS27A (Sharma *et al.*, 2004)
- One RAPD marker (OPJ20600) linked with resistance to FW (Rubio *et al.*, 2003)
- Plus many more RAPDs for FW
- One SSR linked to a QTL for root traits (drought avoidance) (Junichi Kashiwagi)

# WHERE ARE WE? – PIGEONPEA (*Cajanus cajan*)

## Markers

A RAPD marker associated with male sterility (Souframanien *et al.*, 2003)

20 SSR markers with only about 10 showing polymorphism (Burns *et al.*, 2001)

More SSR markers on the way and about 44 showing polymorphism within cultivated pigeonpea (Odeny *et al.*, unpublished)

FW mapping population available and being screen using SSRs

# WHERE ARE WE? – LENTIL (*Lens culinaris*)

**Genetic maps:** Hamwieh *et al.* 2005 SSRs integrated into previous maps ...

14 linkage groups (LGs)

751 cM total map distance

2.6 cM between markers

## Markers mapped

2 flanking RAPDs and 3 AFLPs linked to a major dominant gene, *LCt-2* confers resistance to Anthracnose (Tullu *et al.*, 2003)

2 flanking RAPDs linked to a recessive gene, *ra12* confers resistance to AB (Chowdhury *et al.*, 2001)

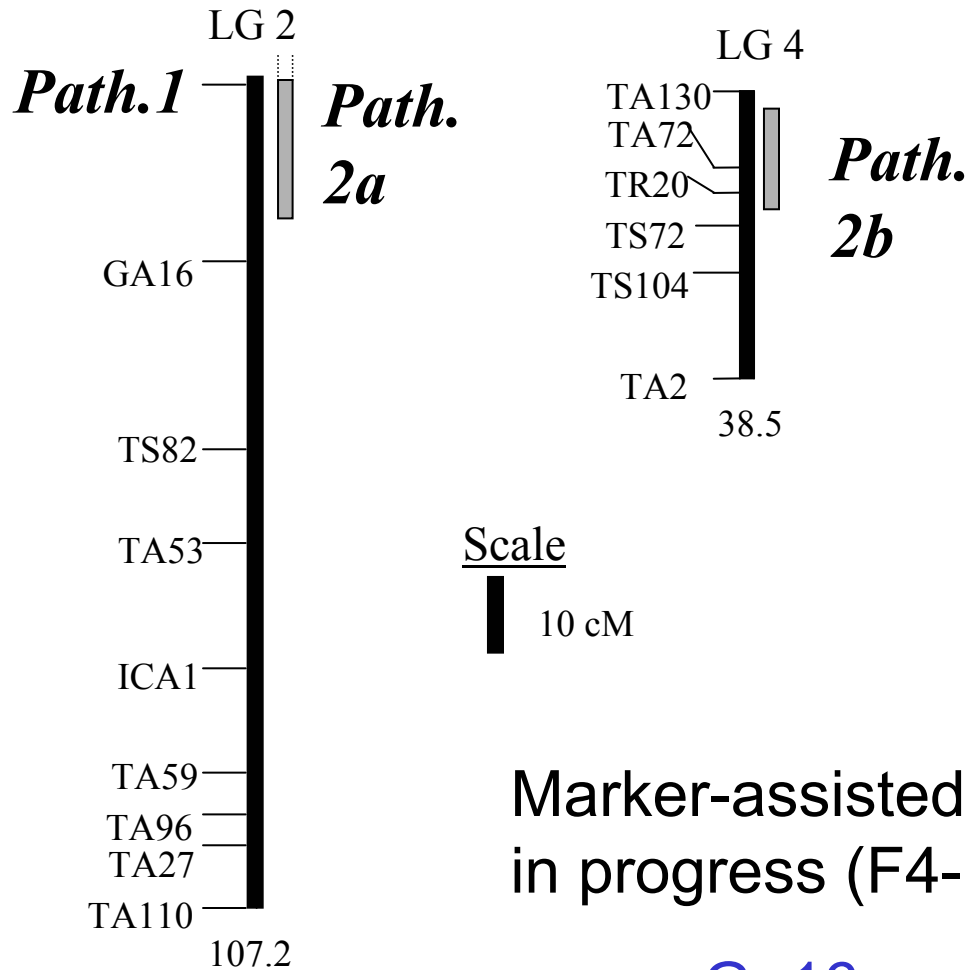
**2 SSRs for AB resistance: LG2 and LG4**

A RAPD marker linked to frost tolerance (Eujayl *et al.*, 1998)

Fusarium vascular wilt resistance (LG6) *SSR59-2B* and *AFLP p17m30710* at a distance of 8.0 cM and 3.5 cM, respectively

# WHAT NEXT? - LENTIL MAS

## Molecular Mapping of AB resistance



Udupa and Baum (2003).  
TAG, 106: 1196-1202

Marker-assisted selection for AB resistance is in progress (F4-F5 generations):

Ga16 and Ts72 SSRs

## SUMMARY - MAS LEGUMES

- Cowpea: *Striga* resistance - 61R SCAR marker
- Lentil: AB resistance - TS72 and GA16 both SSR MAS on progress
- Groundnut: ??
- Chickpea: ??
- Pigeoepa: ??

No markers for drought tolerance that can move to MAS in the near future?

Markers mapped for most traits seem to be those that are potentially difficult to implement for MAS?

**For GCP what can we do? ... cereals are far ahead!**

**Thank you ...**