

# MAS for *Striga* resistance in cowpea and selection of *Striga* resistant varieties in West and Central Africa

**Generation Challenge Program: Project No. 6**

**Marker Development and Marker-Assisted Selection for *Striga* Resistance in Cowpea**

IITA: S. Muranaka, C. Fatokun, O. Boukar, D.J. Kim, A. Raji

UVA: M. P. Timko

CERAAS : N. Cisse

CNRA-Senegal: M. Wade

## What is *Striga*?

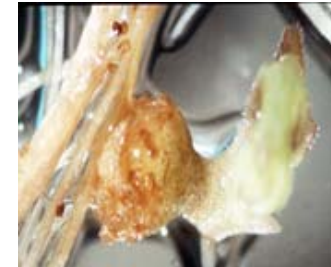


Disturb/terminate cowpea production

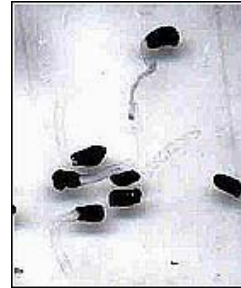
Emergence



Tubercle formation



Germination



- Major parasitic weed of cowpea in Africa
- 15-100% yield loss under infested condition
- More than 10 years of seed lifetime
- Rapid increase of *Striga* infested area

## Clear Genetic Differences under *Striga* Infestation

*Under Striga infested condition...*



*Striga resistance*

B301  
(Resistant)

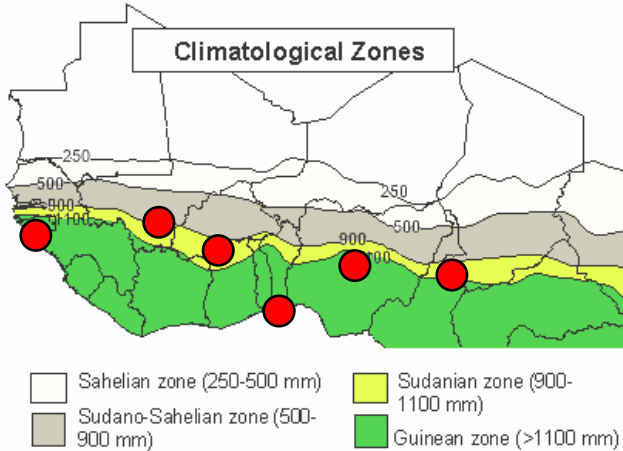
IT97K-461-4  
(Susceptible)



*Striga tolerance*

RIL population (114: Dan Ila x TVu7778)

# Striga Hot-Spot Trial - 6 Different Striga Races



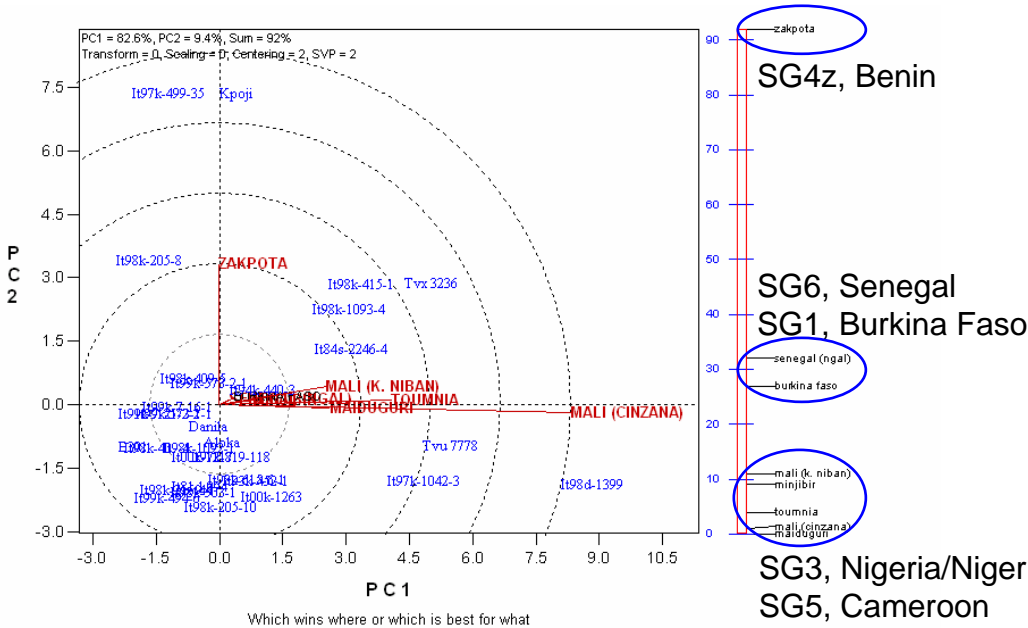
Based on mean annual rainfall 1961-90, SDRN-FAO Rome

Source: Sahel Report No.3, 2004,  
FAO Corporate Document Repository



S/N Cowpea lines	Burkina Faso (SG1)	Mali (SG2)	Nigeria (SG3)	Benin (SG4z)	Cameroon (SG5)	Senegal (SG6)	Tested year
1 IT98K-205-8	R*	R	R	S	R	S	05-06
2 IT00K-1217	S	RR	RR	S	S	S	05-06
3 IT97K-499-35	S	S	RR	S	S	S	05-06
4 IT98D-1399	S	S	S	S	S	R	05-06
5 TVx 3236	S	S	S	S	S	S	05-06
6 IT84S-2246-4	S	S	S	S	S	S	05-06
7 IT81D-994	R	S	S	RR	S	S	05-06
8 IT98K-216-44	RR	R	S	RR	S	S	05-06
9 IT00K-1263	S	S	RR	S	S	R	05-06
10 B301	RR	RR	RR	S	RR	S	05-06
11 Aloka	S	S	S	S	RR	S	05-06
12 TVu 7778	S	S	S	S	S	S	05-06
13 Danila	R	S	S	S	S	S	05-06
14 IT93K-452-1	S	S	S	S	S	R	05
15 IT94K-440-3	R	S	S	S	S	S	05
16 IT97K-1042-3	S	S	S	S	S	S	05
17 IT97K-819-118	R	S	S	S	S	S	05
18 IT98K-1092-1	S	S	R	S	R	S	05
19 IT98K-1093-4	S	S	S	S	S	S	05
20 IT98K-205-10	S	S	S	R	S	R	05
21 IT98K-409-4	R	R	R	S	S	RR	05
22 IT98K-409-5	S	S	S	S	S	RR	05
23 IT98K-415-1	S	S	S	S	S	RR	05
24 IT98K-503-1	R	S	S	R	S	RR	05
25 IT98K-615-6-1	S	S	S	S	S	S	05
26 IT99K-494-6	RR	S	RR	R	S	S	05
27 IT99K-573-1-1	RR	S	RR	S	S	RR	05
28 IT99K-573-2-1	RR	S	RR	S	S	RR	05
29 IT99K-7-16-1	S	S	S	S	S	RR	05
30 IT99K-7-21-2-2	S	R	S	S	S	RR	05
31 Tvu 14676	RR	RR	R	S	R	RR	06
32 IT89KD-374-57	RR	RR	S	S	S	S	06
33 IT95K-238-3	S	S	S	S	S	RR	06
34 IT97K-461-4	S	S	S	S	S	RR	06
35 IT99K-241-2	RR	S	S	S	S	RR	06
36 Bambey	S	S	S	S	S	S	06
37 Mouride	R	S	S	R	R	R	06

# Source of *Striga* Resistant Genes



GGE biplot analysis of emerged *Striga* number at 9 wks after planting in 2005


- IT81D-994 (SG1, 4z)
- IT98K-503-1(SG1, 4z)
- IT98K-205-10 (SG4z, 6)
- IT99K-494-6 (SG1, 3, 4z)
- IT98K-216-44 (SG1,2,4z)

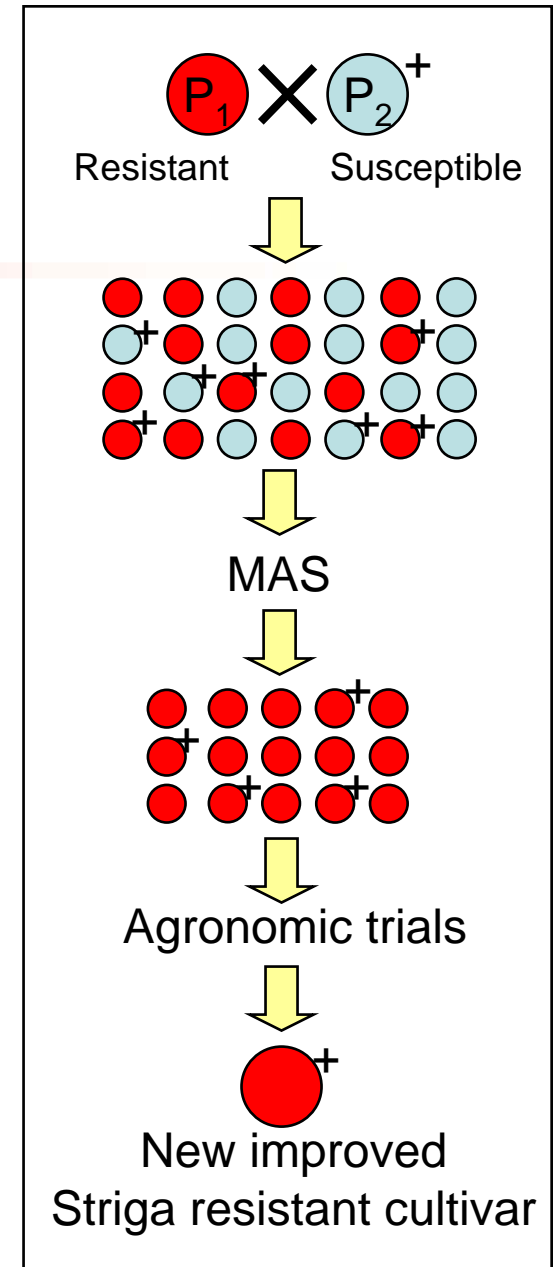
## B301 (SG1, 2, 3, 5, 6\*)

- ➔ IT98K-205-8 (SG1, 2, 3, 5)
- ➔ IT97K-499-35 (SG3)
- ➔ IT99K-573-2-1 (SG1, 3, 6)

# Application of Marker Assisted Selection

## Advantage

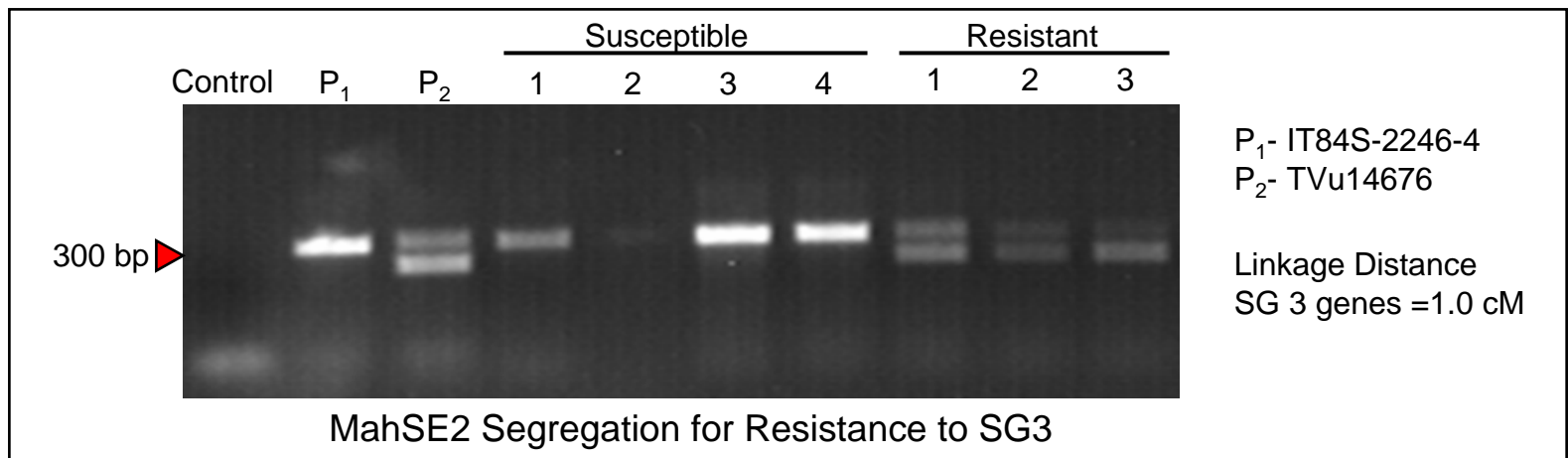
- Short time to bring new varieties to market
  - Avoid genetic - environmental interactions
  - Efficient and effective crop trait selection
- 
- Reduce population size
  - Rapid selection (3 generation per year)
  - Association with other agronomic trials
  - Initial population development from distant location
  - Pyramiding of different *Striga* resistance genes



## Markers for *Striga* Resistance

### Two SCAR markers developed for SG3 resistance:

- SCAR 61R for SG1 and SG3 (LG1)
- MahSE2 for SG1 and SG3 (LG1)



### And more:

524B X IT84S-2049  
TVu14676 x IT84S-2246-4  
IT97K-499-35 x IT97K-461-4  
IT81D-994 x TVx3236

Placement of markers on genetic map  
Currently being used for SG2 mapping  
Being evaluated for SG2 resistance  
Being evaluated for SG1 on LG6 and SG4z

# Marker Validation for SG3 Resistance



S/N	Tested Lines	SG3	61R	MahSE2	S/N	Tested Lines	SG3	61R	MahSE2
1	IT98K-1092-1	R <sup>1)</sup>	- <sup>2)</sup>	-	31	Mouride	S	-	-
2	IT93K-573-2-1	R	-	+	32	IT82D-849	S	-	-
3	IT00K-1263	R	+	-	33	IT95K-238-3	S	-	-
4	IT98K-409-5	R	+	-	34	IT97K-461-4	S	-	-
5	B301	R	+	+	35	IT97K-1101-5	S	-	-
6	IT00K-1217	R	+	+	36	IT84S-2049	S	-	-
7	IT97K-205-8	R	+	+	37	IT90K-277-2	S	-	-
8	IT97K-499-35	R	+	+	38	Borno local	S	-	-
9	IT98K-205-10	R	+	+	39	Kanannado brown	S	-	-
10	IT98K-409-4	R	+	+	40	IT89KD-391	S	-	-
11	IT98K-503-1	R	+	+	41	IT89KD-288	S	-	-
12	IT99K-494-6	R	+	+	42	IT98K-131-2	S	-	-
13	IT99K-573-1-1	R	+	+	43	IT97K-568-18	S	-	-
14	IT99K-7-21-2-2	R	+	+	44	IT99K-241-2	S	-	-
15	TVu14676	R	+	+	45	Gorom local	S	-	-
16	TVu2251	R	+	+	46	58-57	S	-	-
17	IT97K-499-38	R	+	+	47	IT93K-452-1	S	-	+
18	IT97K-499-39	R	+	+	48	Tvu1267	S	-	+
19	IT93K-693-2	R	+	+	49	IT96D-604	S	-	+
20	TN-5-78	R	+	+	50	BOSADP	S	-	+
21	IT81D-994	S	-	-	51	IT97K-819-118	S	+	-
22	IT84S-2246-4	S	-	-	52	Tvu11986	S	+	-
23	IT94K-440-3	S	-	-	53	TN121-8	S	+	-
24	IT97K-1042-3	S	-	-	54	IT98D-1399	S	+	+
25	IT98K-1093-4	S	-	-	55	IT98K-415-1	S	+	+
26	IT98K-216-44	S	-	-	56	IT98K-615-6-1	S	+	+
27	Tvu7778	S	-	-	57	IT99K-7-16-1	S	+	+
28	Tvx3236	S	-	-	58	Aloka local	S	+	+
29	Danlla	S	-	-	59	Bambey-21	S	+	+
30	Suvita-2	S	-	-	60	524B	S	+	+

Strong correlation of 61R (79%) and MahSE2 (77%) with SG3 resistance

# Improved line for Nigeria *via* MAS

## Testing population for SG3 resistance MAS

### F<sub>2</sub> stage

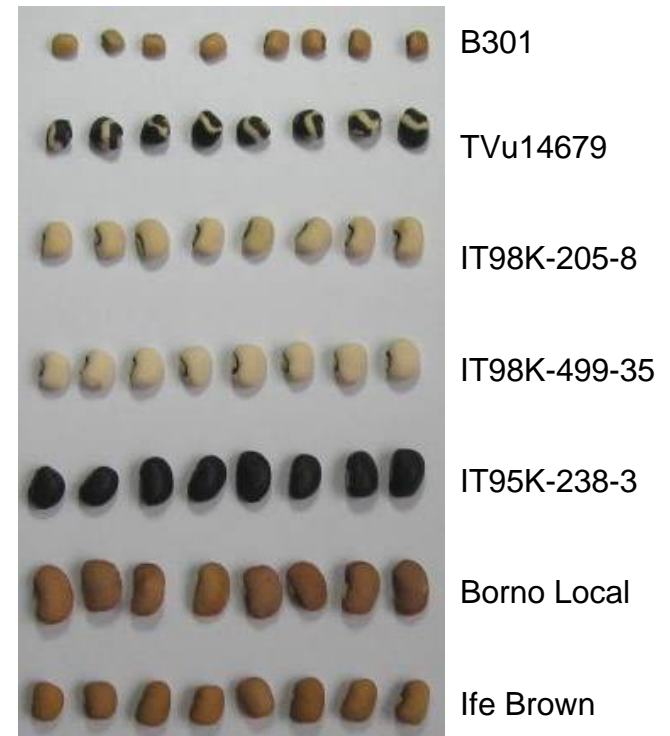
- IT03K-338-1 x Borno Local  
(Target: SG3 resistance, brown large seed)

### F<sub>3</sub> stage

- IT97K-499-35 x Ife Brown  
(Target: SG3 resistance, brown seed)

### F<sub>4</sub> stage

- IT97K-205-8 x IT95K-238-3  
(Target: SG1, 2, 3 and 5, large seed size)
- IT97K-499-35 x Dan Ila  
(Target: SG3 resistance, high yielding)
- \* - IT97K-499-35 x Aloka local  
(Target: SG3 resistance, adaptation to Sahel)



# IT06K-42 series (44 F<sub>3</sub> lines)

## IT97K-205-8:

- SG3 resistance
- Medium seed (15.5g)
- White colour, Black eye
- Early maturing (65days)
- Rough surface



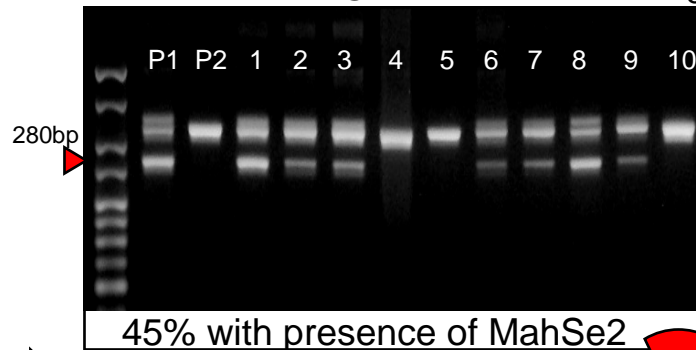
X

## IT95K-238-3:

- SG3 susceptible
- large seed (19.3g)
- Black seed, White eye
- Late maturing (80days)
- Smooth surface



## MAS for *Striga* resistance (F<sub>3</sub>)



## Agronomic traits (F<sub>4</sub>)

- White seed: 30%
- Large seed: 41%
- Early maturing: 30%
- Rough surface: 14%

Go for field test



Large, White  
Rough surface  
Early maturing  
SG3 resistance

## Development of MAS Tool Kit for Cowpea

- Mini germplasm set for identify *Striga* race
- Germplasm data base with agronomic traits
  - Combination of IITA cowpea data base
  - Linking with GPS data
- Seed distribution system
  - via IITA Cowpea International Trial
- Web-base cowpea manual
  - "Step by step" protocols of MAS
  - Feed back system from users*
- Easier DNA extraction methods
  - No -80°C freezer
  - No liquid N<sub>2</sub>
  - Rapid - targeting >2000 samples
- Appropriate low cost PCR condition for breeder



 MAS protocol

## Bottlenecks to Introduce MAS to NARS Breeding Program

Development for more markers for more traits

How to associate with other selection criteria?

How develop human and physical capacities?

How to shear the idea and tools?

### **NARS cowpea breeders**

*with Special thanks!!*

- INERA (Burkina Faso): J. Ouedraogo
- IRAD (Cameroon): O. Boukar, G. Sobda
- INRAN (Niger): M. Musa, M. Maman
- IER (Mali): M. Toure
- SARI (Ghana): F. Padi