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

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Cowpea Witch Weed - *Striga gesnerioides*

Parasitic weeds of the genus *Striga*, especially *S. gesnerioides* (Willd) parasitizing cowpea, are very important biological constraint in semi-arid and arid African agriculture. In these regions, yield losses by *S. gesnerioides* are estimated in millions of tons annually and prevalence of *Striga* soil infestation is steadily increasing.

Based on the differential resistance reaction exhibited by various cowpea genotypes, 7 different *Striga* races (*SG1*, *2*, *3*, *4*, *4z*, *5* and *6*) have been identified in West and Central Africa currently. The ability of cowpea genotypes to resist *S. gesnerioides* parasitism depends on geographic origin of the parasite. Though most of the local varieties are susceptible to the *Striga* race in the region, some land races and breeding lines are identified as *Striga* resistant.

Striga gesnerioides infested field in Benin Rep.
Striga terminated all susceptible cowpea lines in the farmers field.

Striga resistant "B301" and susceptible "IT98K-461-4" under *SG3* infested condition

Conventional breeding efforts have developed some varieties for the *Striga* problems as well as other important agronomic and resistance traits, but it is time-consuming and difficult to pyramid favorable traits. The Marker Assisted Selection (MAS) is a modern and potential tool to fast track the breeding process and increase efficiency of breeding activities.

The Striga hotspot trial for identification of resistant genetic resources

The *Striga* hotspot trial has been conducted to identify favourable *Striga* resistant genetic resources for different *Striga* races in West and Central Africa. So far, out of 48 lines tested, some cowpea lines were selected as potential parent lines for *Striga* resistance in cowpea (Table 1). *Via* two trials in 2005 (9 locations) and 2006 (11 locations), IT98K-205-8 was identified as multiple *Striga* race resistant line (resistant to SG1, *2*, 3 and *5*) with beneficial agronomic traits, such as larger seed size, white seed colour, early maturity (60 days), high-grain yield and disease resistance (Fig.1).
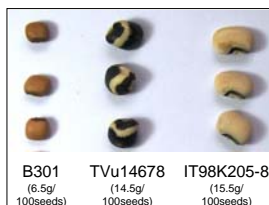

| B301 | TVu14678 | IT98K205-8 |
| (6.5g/ 100seeds) | (14.5g/ 100seeds) | (15.5g/ 100seeds) |

Fig. 1. Seed color/size of three multiple *Striga* race resistant lines

Table 1. Potential parent lines for *Striga* resistance

Lines	Burkina Faso (SG1)	Mali (SG2)	Nigeria (SG3)	Benin (SG4z)	Cameroon (SG5)	Senegal (SG6)
B301	R[1]	R	R	S	R	S
TVu14768	R	R	R	S	R	R
IT98K-205-8	R	R	R	S	R	S
IT98K-216-44	R	R	S	R	S	S
IT81D-994	R	S	S	R	S	S
IT98K-503-1	R	S	S	R	S	R

[1] R and S mean Striga resistance and susceptible respectively

Also, IT98K-216-44, IT81D-994 and IT98K-503-1 were identified resistant cowpea lines to *SG4z*, Striga race in Zakpota, Benin Rep. which multiple *Striga* resistant cowpea lines can not overcome.

In 2007, 20 selected *Striga* resistant lines based on the previous two trials have been tested in 15 locations in 8 countries of West and Central Africa (Fig. 2).
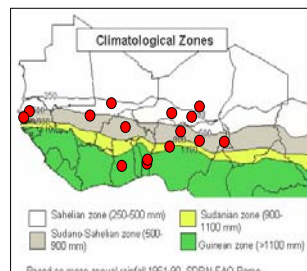

Fig. 2. Fifteen *Striga* hotspot trial sites in 2008

Development of markers and MAS method for *Striga* resistance

The development of new markers for all race specific *Striga* resistances with four RIL populations is one of major project targets (Table 2). Currently, for MAS of *Striga* resistance in Cowpea, 3 SCAR markers have been developed for S*G1* and *SG3* resistance genes in LG1 and validated for *SG3* resistance with 60 cowpea lines.

Table 2. RIL populations for marker development of race specific *Striga* resistance

S/N	Parents combination	Target	Source
1	TVu14676 x IT84S-2246-4	*SG1-5* resistance	IITA
2	IT81D-994 x TVx 3236	*SG1* and *SG4z* resistance	IITA
3	Dan Ila x TVu 7778	*SG1* resistance	IITA
4	Mouride x Bambey 21	*SG6* resistance	CERAAS

The marker efficiencies of the SCAR 61R and MahSE2 in detecting *SG3* resistant cowpea were 79% and 77% respectively (Table 3). To estimate MAS efficiency, four F_2 - F_4 populations (IT98K-205-8 x IT98K-238-3, IT97K-499-35 x Dan Ila, IT97K-499-35 x Ife brown, IT00K-338-1 x Borno local) have been developed *via* MAS with 61R and MahSE2 and will be tested for *SG3* resistance at F_5 stage for further selection.

Table 3. *Striga* resistance of 60 cowpea lines for *SG3* and presence of 61R and MahSE2 markers

S/N	Tested Lines	SG3	61R	MahSE2	S/N	Tested Lines	SG3	61R	MahSE2
1	IT98K-1092-1	R[1]	-[2]	-	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	DanIla	S	-	-	59	Bambey-21	S	+	+
30	Suvita-2	S	-	-	60	524B	S	+	+

[1] R and S mean *Striga* resistant and susceptible respectively
[2] + and - mean *presence* and absence of marker respectively