Pathogen variability and identification of new sources of resistance to angular leaf spot in Uganda common bean landraces

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Pan-African Grain Legume & World Cowpea Conference

CIAT International Center for Tropical Agriculture Since 1967 / Science to cultivate change

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Introduction

- Angular leaf spot (ALS) ranks 2nd among biotic constraints to bean production

  ✓Cause 50% yield loss

  ✓Reduces market value

  ✓Deteriorates seed quality

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Developing resistance to pathogen

Challenges

- ✓Pathogen variability & evolution of new races
- ✓Existing sources of resistance are not adapted

Objective of study

- ✓To understand the pathogen variability and identify new sources of resistance to ALS

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Determine the variability of *P. griseola*

Morphological Approach

- 45 *P. griseola* isolates & 12 ALS differential cultivars
- Green house trial, 3 replications
- Resistance indices (CIAT Scale 1-9)

Molecular Approach

- DNA extraction & Amplification (Mahuku's protocol)
- RAMS and conserved primers
- Hierarchical clustering (MEGA 5.0)

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Results

Based on ALS differential cultivars:

- ✓ Variability detected by differential cultivars
- ✓ 12 *P. griseola* pathotypes identified
- ✓Pathotype 61:63 most virulent

Andean group[a]						Mesoamerican group[b]						Pathotype[c]	Number of isolates
a	b	c	d	e	f	g	h	I	j	k	l		
1	2	4	8	16	32	1	2	4	8	16	32		
+	-	+	-	+	-	+	+	+	-	-	+	21:39	8
+	-	-	-	+	-	+	+	+	-	-	+	17:39	5
+	-	-	+	-	+	-	+	+	-	-	-	41:6	2
+	-	+	-	-	-	+	+	+	+	+	-	5:31	2
+	-	+	-	+	-	+	+	+	-	-	+	21:38	4
+	-	+	-	-	-	+	+	+	-	+	+	5:55	2
+	-	+	-	-	-	+	-	+	+	-	-	13:13	2
+	-	+	-	-	-	-	+	+	+	+	-	5:30	4
+	-	+	-	-	-	-	+	+	-	-	-	5:6	2
+	-	-	-	+	-	+	+	+	-	+	-	17:23	11
+	-	+	+	-	-	+	+	+	-	+	+	13:55	2
+	-	+	+	+	+	+	+	+	+	+	+	61:63	1

[ab]Andean groups included cultivars: (a) Don Timoteo; (b) G 11796; (c) Bloom Bayo; (d) Montcalm; (e) Amendoin; (f) G 5686. Middle American group included cultivars: (g) Pan 72; (h) G 2858; (i) Flor de Mayo; (j) Mexico 54; (k) BAT 332; (l) Cornell 49–242. [c]Pathotype designation is based on the sum (binary values) of bean cultivars with 10 scale value. (+), Compatible reaction; (-), Incompatible reaction.

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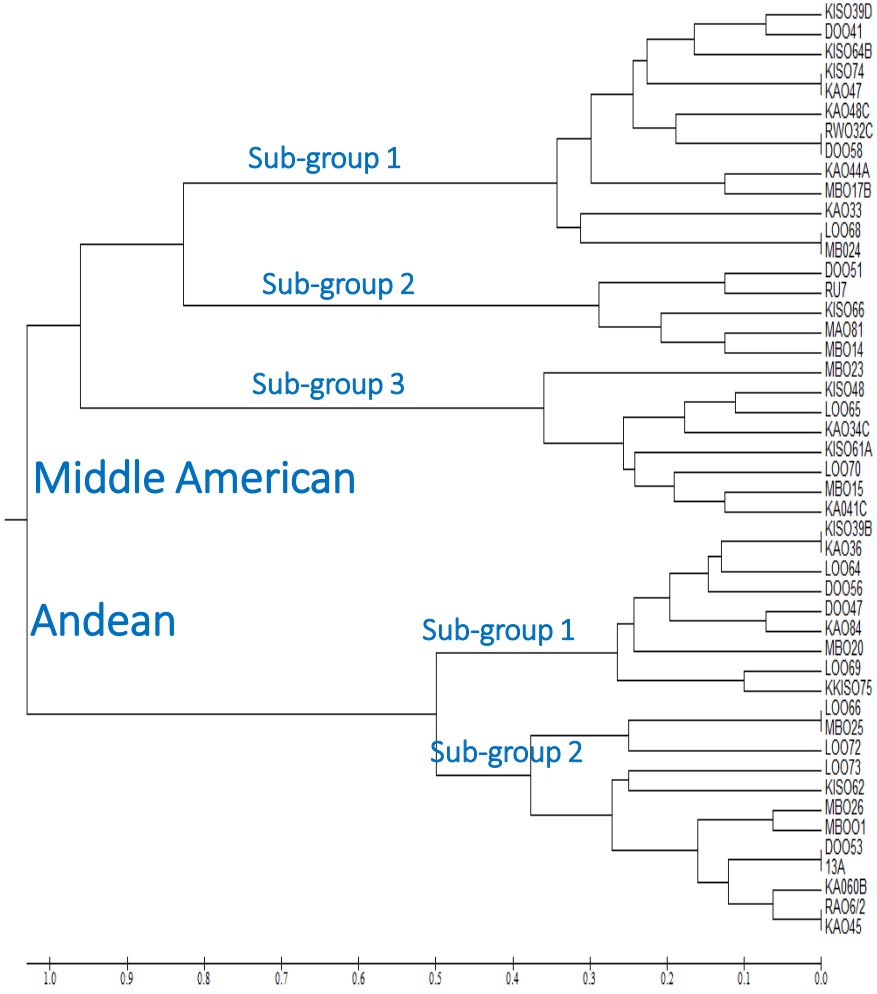
Results

Based on molecular markers

- ✓ 2 main groups identified
- ✓ 5 subgroups detected
  3-Middle American
- ✓ 2- Andeans
- ✓30 *P. griseola* haplotypes identified
- ✓ High variability detected compared to differentials approach



Dendogram generated based on RAMS and REP bands from 45 P. griseola isolates from Uganda and control isolates (RU7 and 13A) from CIAT, a representative group 1 (Middle Ameri[illegible] representative group 2 (Andean)

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Identification of new sources of ALS resistance

Approach

- ✓74 landraces, 4 released varieties & 2 controls
- ✓ *P. griseola* isolates (1:6,21:39,17:39,61:63)
- ✓screen house trial with 3 replications
- ✓Resistance indices (CIAT Scale 1-9).
- ✓Area under disease progressive curve(AUDPC)

$$\text{AUDPC} = \sum_{i=1}^{k} 1/2\,[(s_i + s_{i+1})(t_{i+1} - t_i)]$$

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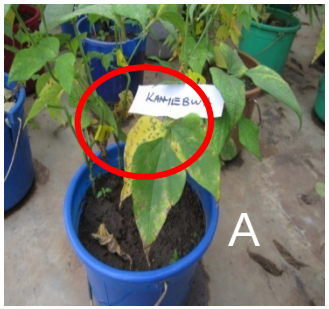
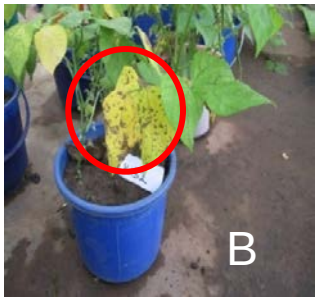
Reaction of landraces , released varieties and controls to *P. griseola*

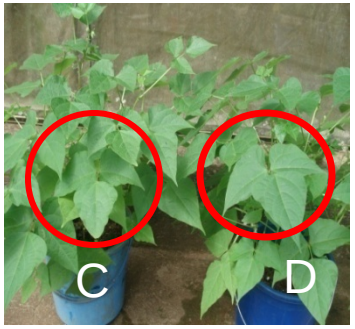
- A: K132-released variety showed ALS symptoms





- B: Kanyebwa- susceptible check exhibited ALS symptoms

- C: landrace U00297 no ALS symptom



- D: BAT 332- resistant check, no ALS control

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Determine the mode ALS resistance inheritance in U00297

Parents:

- Resistant; G5686, Mexico 54, U00297 and AND277
- Susceptible; K131,K132, Kanyebwa

Approach

- Full diallel analysis Griffing's Method 2
- Resistance indices (CIAT scale 1-9)

Test

- Chi-Square test (inheritance)

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Results

Based on segregation ratios of F_2 populations:

✓ K132 xU00297 & KB x U00297 inoculated with 17:39 fitted 3:1 test ratio

✓KB xU00297 &K131 x U00297 inoculated with 61:63 &17:39 fitted 9: 7 test ratio

✓ K132 xU00297 &K131 x U00297 inoculated with 61:63 & 21:39 fitted 7: 9 test ratio

Reaction of F_2, back cross progenies to inoculation of three *P. griseola* pathotypes under screen house conditions

Populations	Pathotypes	Total no. of plants	Observed plants R	Observed plants S	Expected ratio R:S	x^2	P-value
F_2 (K131 x U00297)	61:63	157	72	85	7:9	0.2839	0.5940
F_2 (K132 x U00297)	61:63	166	74	92	7:9	0.0462	0.8296
F_2 (KB x U00297)	61:63	77	47	30	9:7	0.7176	0.3969
BC_{K132}	61:63	58	27	31	1:1	0.2759	0.5994
BC_{K131}	61:63	53	25	28	1:1	0.1698	0.6803
BC_{KB}	61:63	61	32	29	1:1	0.8251	0.3637
BC_{U00297}	61:63	47	45	2	1:0	0.0957	0.1915
F_2 (K131 x U00297)	17:39	98	62	36	9:7	1.9598	0.1615
F_2 (K132 x U00297)	17:39	98	70	28	3:1	0.6663	0.4142
F_2 (KB x U00297)	17:39	157	123	34	3:1	0.9363	0.3332
BC_{K132}	17:39	59	28	31	1:1	0.0763	0.1525
BC_{K131}	17:39	67	35	32	1:1	0.1343	0.7140
BC_{KB}	17:39	54	29	25	1:1	0.2963	0.5862
BC_{U00297}	17:39	97	95	2	1:0	0.0000	0.0412
F_2 (K131 x U00297)	21:39	102	41	61	7:9	0.5234	0.4693
F_2 (KB x U00297)	21:39	111	72	39	3:1	6.0810	0.0136
BC_{K132}	21:39	47	25	22	1:1	0.0000	0.0851
BC_{K131}	21:39	64	30	34	1:1	0.2500	0.6171
BC_{KB}	21:39	81	42	39	1:1	0.1111	0.7389
BC_{U00297}	21: 39	16	16	0	1:0	0.0000	1.0000

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Conclusions & Implication

Conclusion

1. Variability exist among Ugandan *P. griseola*

2. Landrace U00297 is resistant to four *P. griseola* races

Implication

1. Different sources of resistance are required to manage ALS

2. U00297 can be a potential source of ALS resistance

3. Resistance in U00297 to race 17:39 is transferable

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