Increasing the resilience of Coffee Production to Leaf Rust and Other Diseases in Kenya, India, Rwanda, Uganda and Zimbabwe

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Presentation outline

- Introduction
- An overview of Coffee Leaf Rust
- The Coffee Leaf Rust Project
- Major findings to date
- Conclusion
- Acknowledgements

Coffee Leaf Rust Disease – Overview

- **Symptoms**
  - Small, light yellow spots about 1mm in diameter first appear on the underside of leaves
  - These quickly enlarge to 3mm in diameter and form masses of yellow, powdery spores, which later turn orange and become surrounded by yellow rings

Coffee Leaf Rust Disease – Overview

- **Symptoms**
  - Tissue in the centre of the spots eventually dies and turns brown
- **Leaf defoliation** and twig/branch die-back

Coffee Leaf Rust Disease – Overview

- The economic impact - through reduction of both quantity and quality of yield and the need to undertake expensive control measures on susceptible cultivars
- Estimated overall global costs of the disease are between US$1b and $3 b/year (Eskes,1989)

Coffee Leaf Rust and Berry Diseases

The Coffee Leaf Rust Project

Duration: Five years

Location: India, Uganda, Kenya, Rwanda and Zimbabwe

Funding Agency: The Common Fund for Commodities

Supervisory Body: International Coffee Organisation, London, United Kingdom

Project executing agency: CABI Africa

Partner Institutions:

- Indian Coffee Board
- Kenya Coffee Research Foundation
- Coffee Research Institute – Uganda
- Institut des Sciences Agronomiques du Rwanda
- Coffee Research Station, Zimbabwe

Areas of research which will be presented

- Biological surveys
- Identification of coffee leaf rust disease races
- Field trials
  - Evaluation of varieties for resistance to CLR and CBD
  - Evaluation of fungicides for the control of CLR
- Potential for molecular markers in coffee breeding

Biological surveys

Methodology

- Biological surveys
- Race typing

Trials

- Trials were initiated in 2009 for:
  - Evaluation of fungicides against coffee leaf rust disease
  - Evaluation of varieties for resistance to coffee leaf rust and coffee berry disease

Results

- Biological surveys

Biological surveys

Eastern Uganda

- A total of 128 farms were sampled in Eastern Uganda,
- 79% were infested with CLR in the region.
- CLR incidence ranged from 0% to 100% with a median of 20%.
- All varieties were susceptible

Rwanda

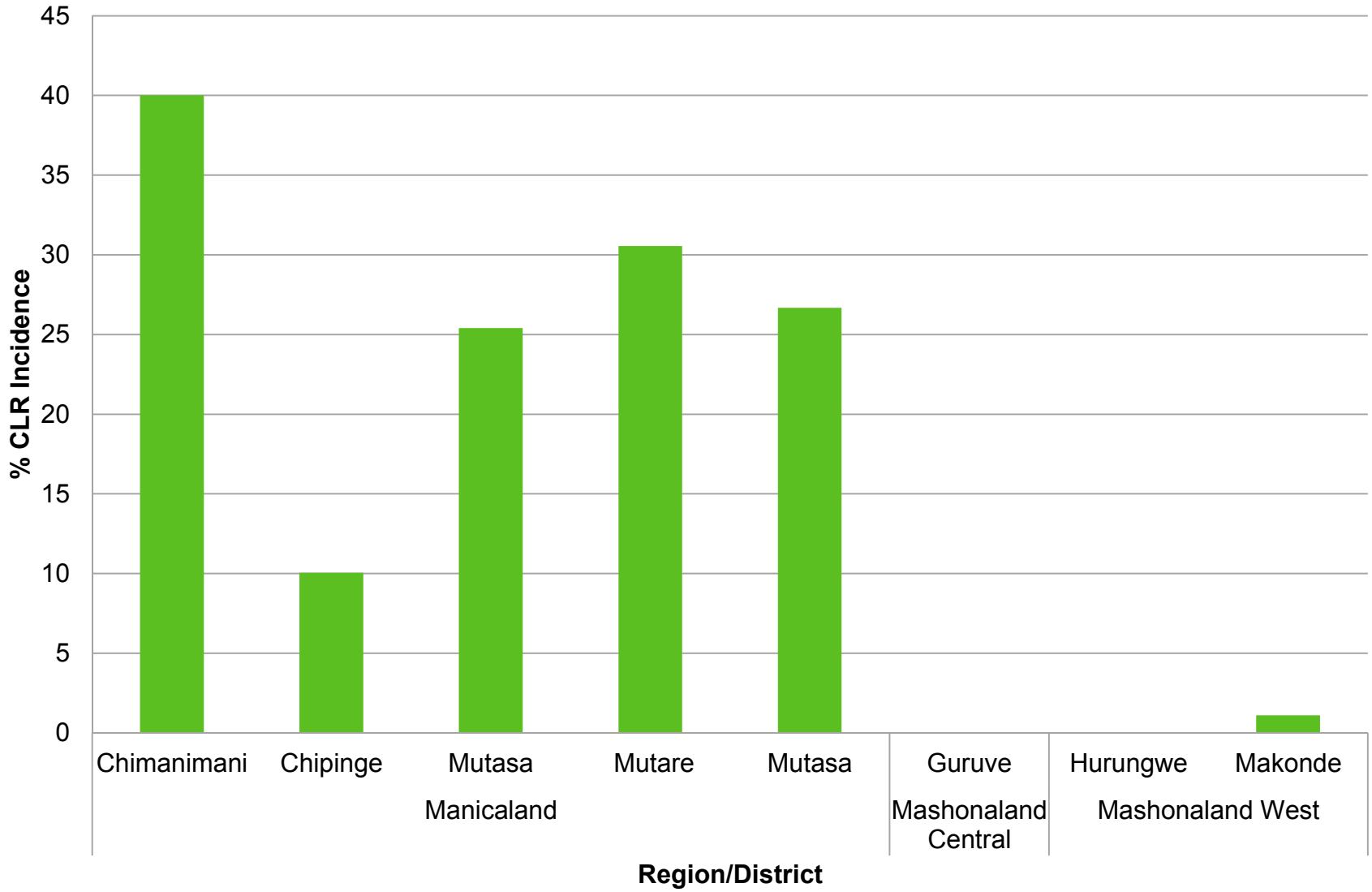
- A total of 307 farms were sampled
- Overall 97% of farms had CLR,
- However, in eastern, northern and southern Rwanda 100% of surveyed farms had CLR
- Incidence on farm ranged from 0% to 100%
- All varieties (Jackson, Bm, Mbirizi, Harrar) were susceptible although Harrar recorded the lowest CLR incidence of 50%

Biological surveys

Zimbabwe

- A total of 160 farms were surveyed, and 47% had CLR
- Among the varieties, Catimor 128 and 129 were very tolerant (1% incidence)
- However, the previously resistant Catimor population (F6) had incidence of 34%
- The most tolerant/resistant variety was Costa Rica (0% incidence)
- An example of distribution of CLR presented for Zimbabwe

Biological survey in Zimbabwe



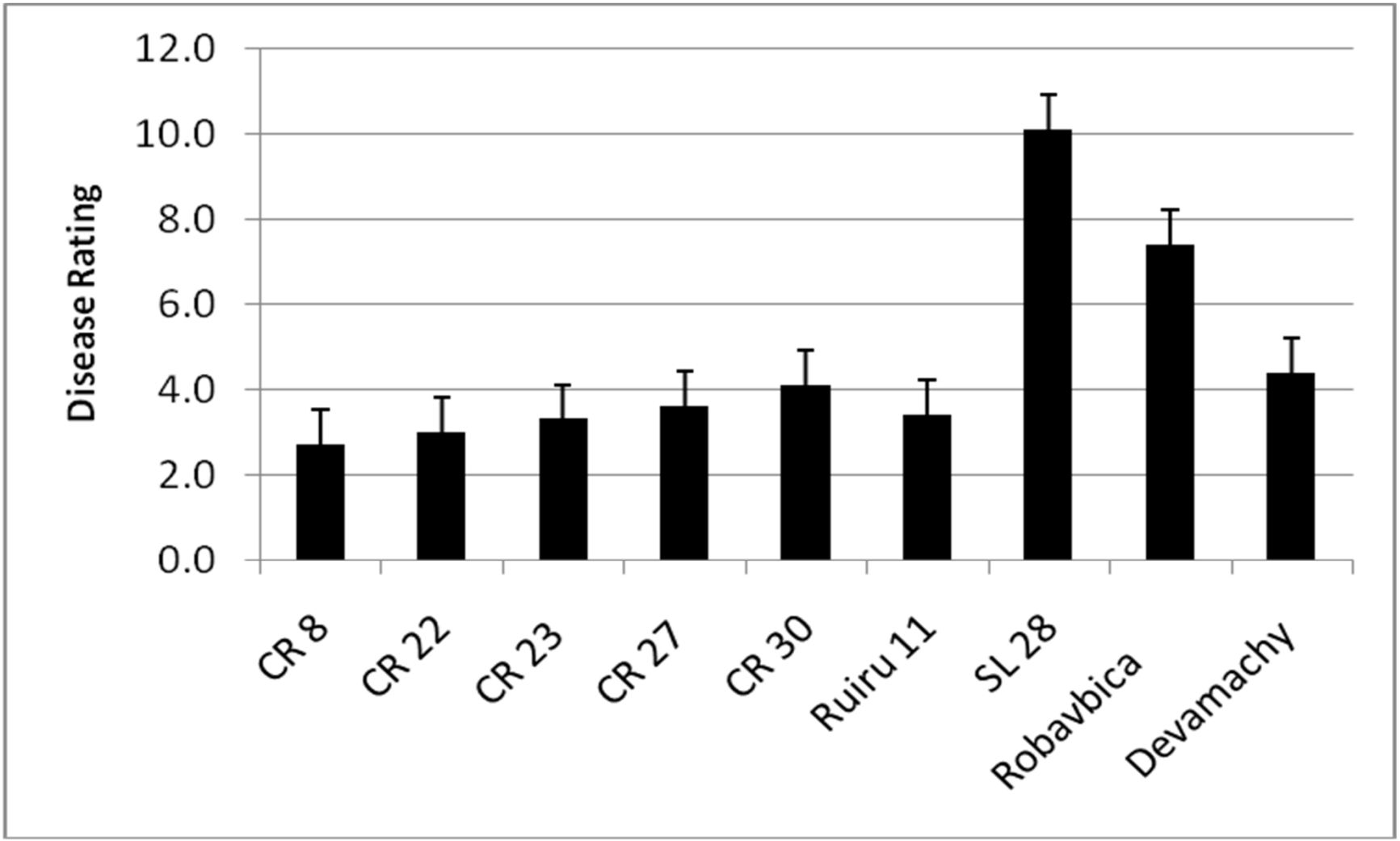
Coffee leaf rust races - Results

Identified CLR races

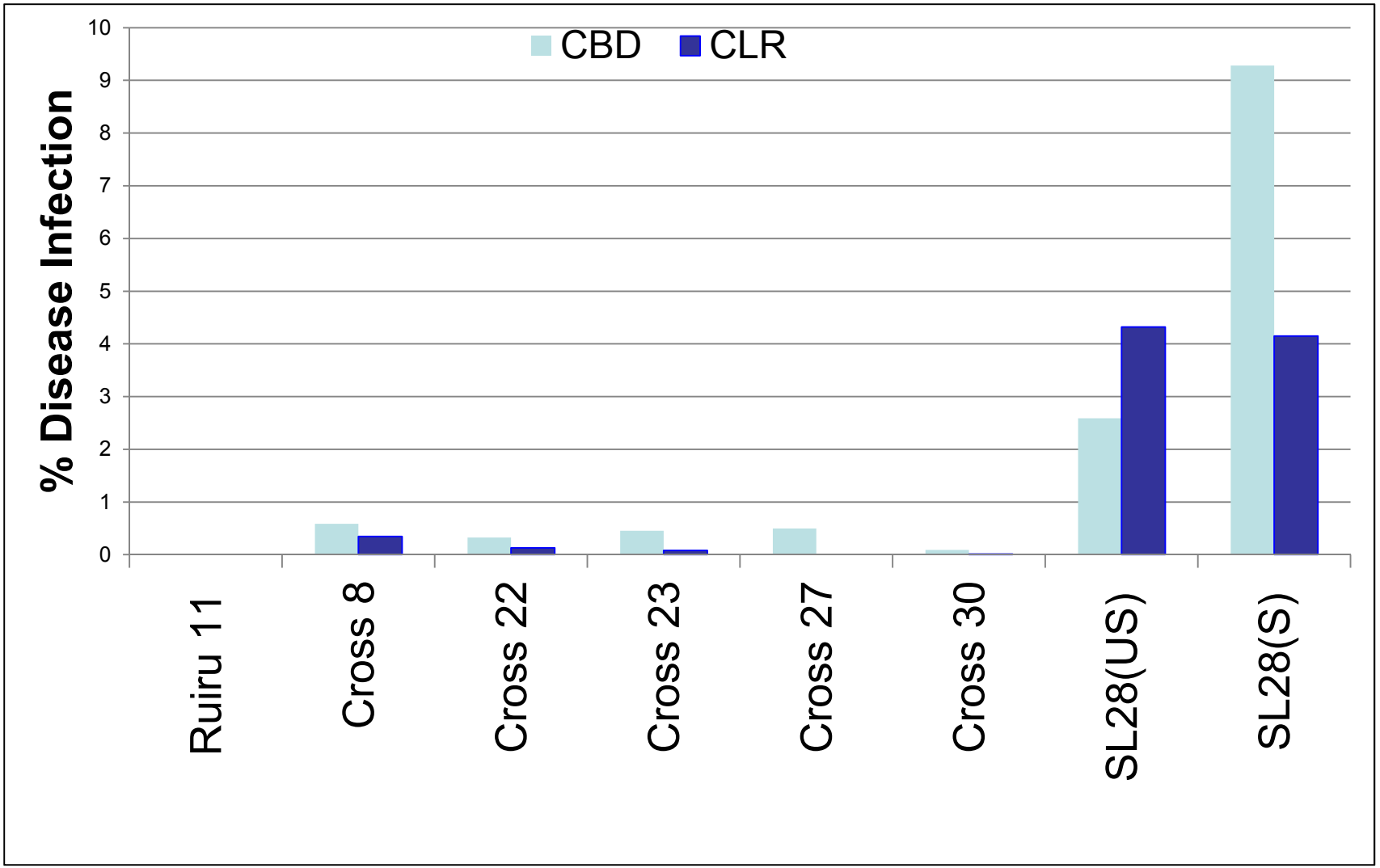
COUNTRY	RACE(S)
Zimbabwe	XXXIV (previously only race II)
Uganda	I, II, XXX, IV
Rwanda	XLI, XV, XXX, XLII, II
Kenya	XLI, I (Second batch still being analyzed)
India	Three new races undergoing confirmation in Portugal

Field trials Results for screening for resistance

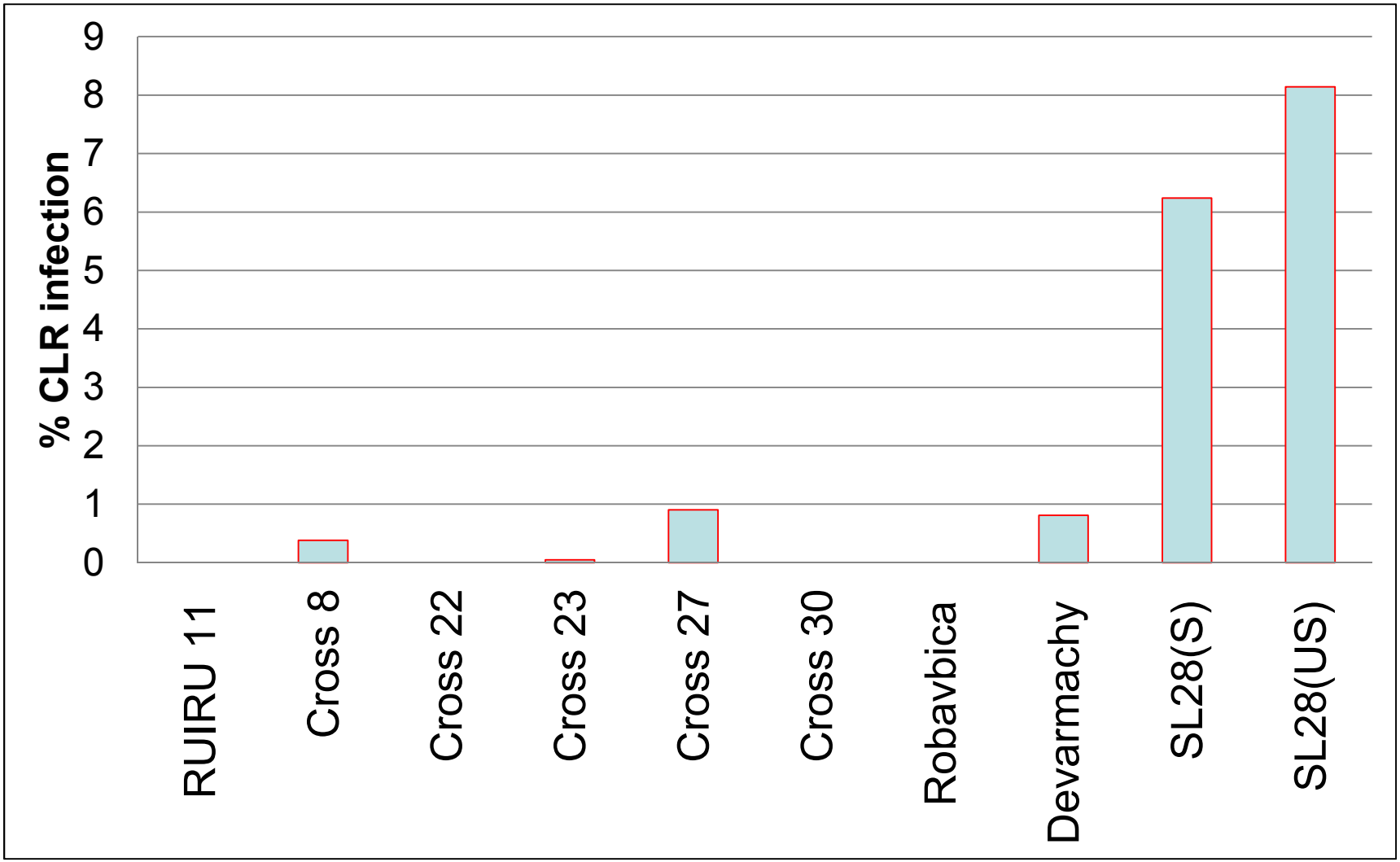
Field trials on farm and station – CBD lab based screening



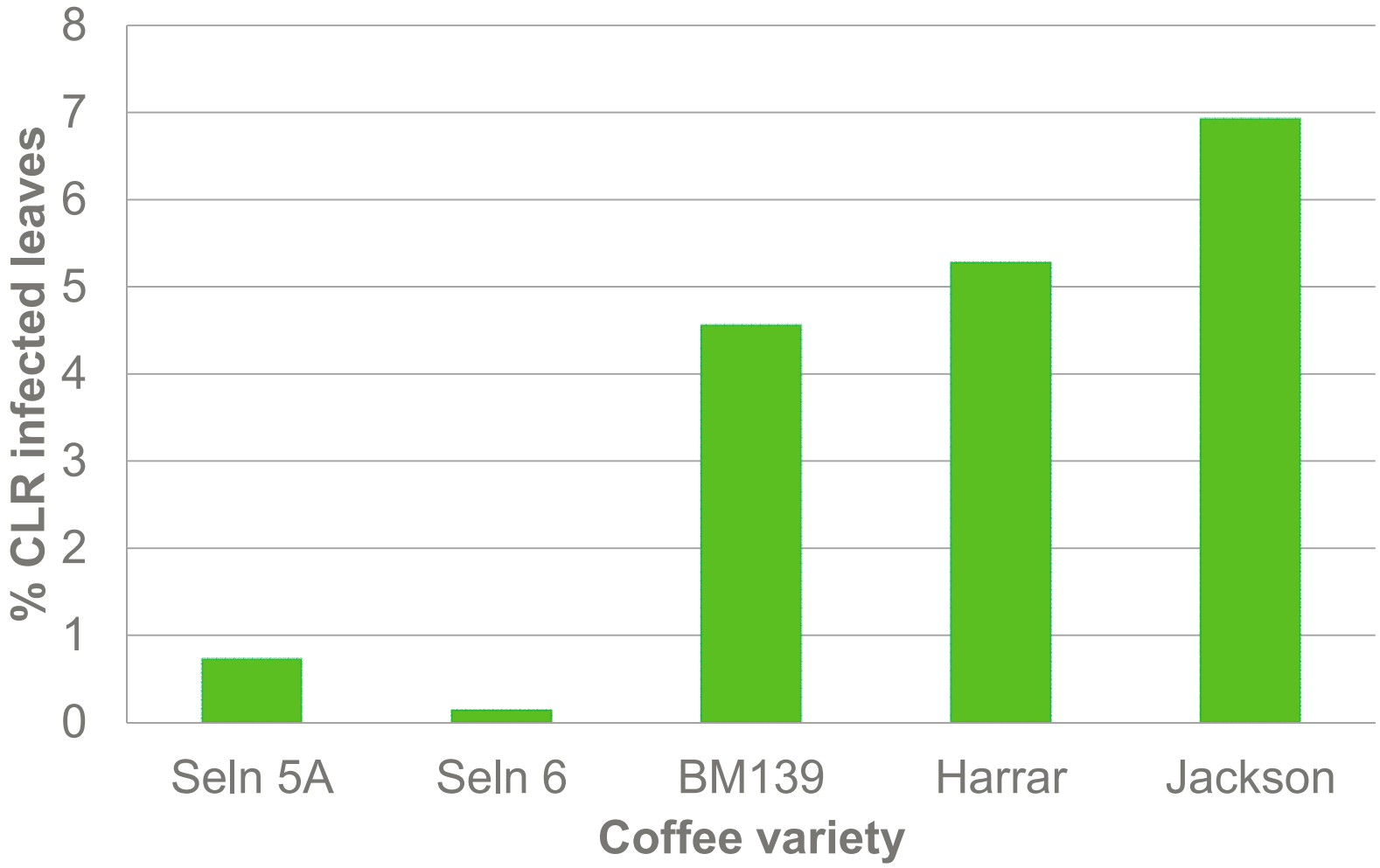
Varietal trials – CBD & CLR (Kenya)



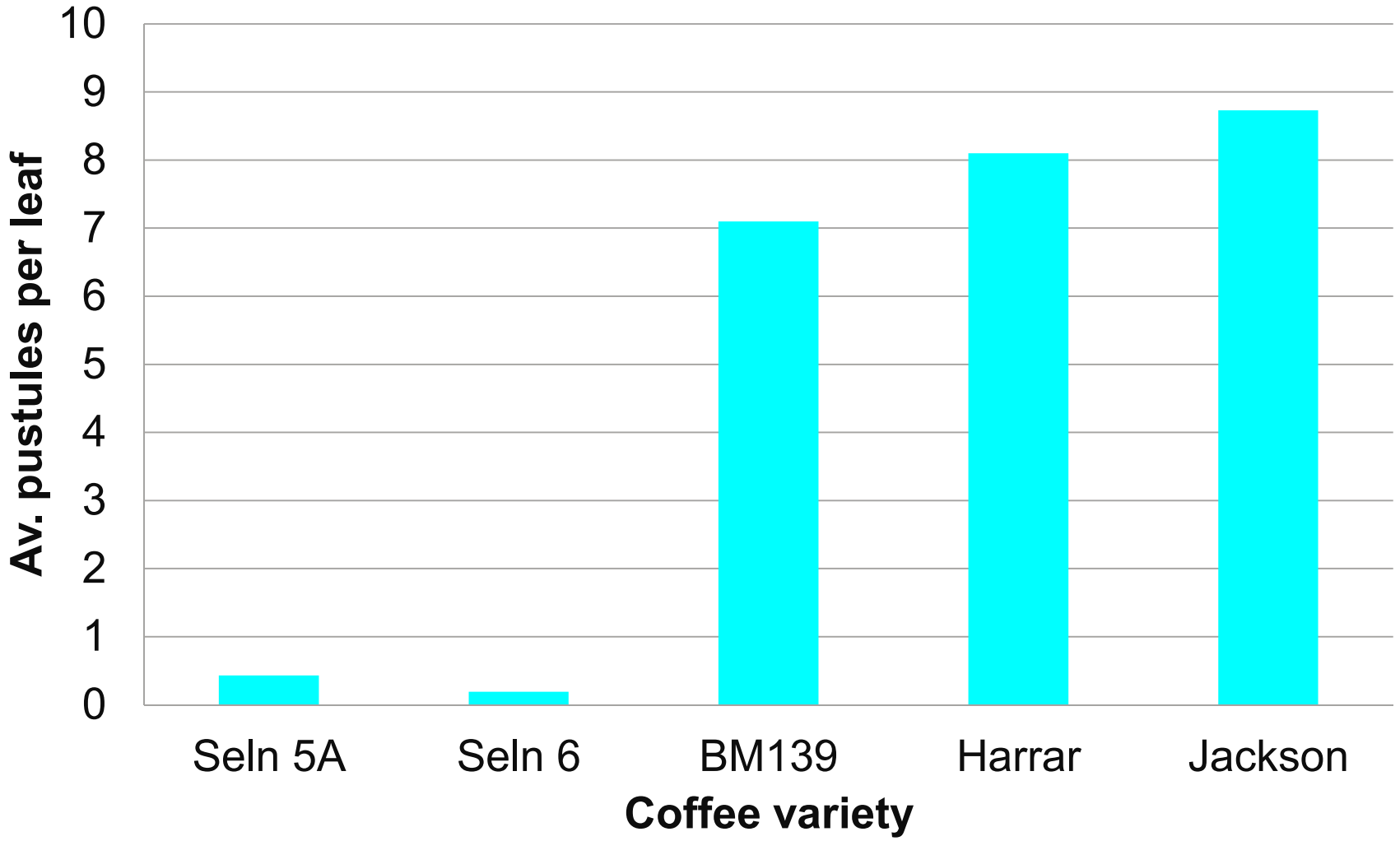
Varietal trials – CLR resistance (Kenya)



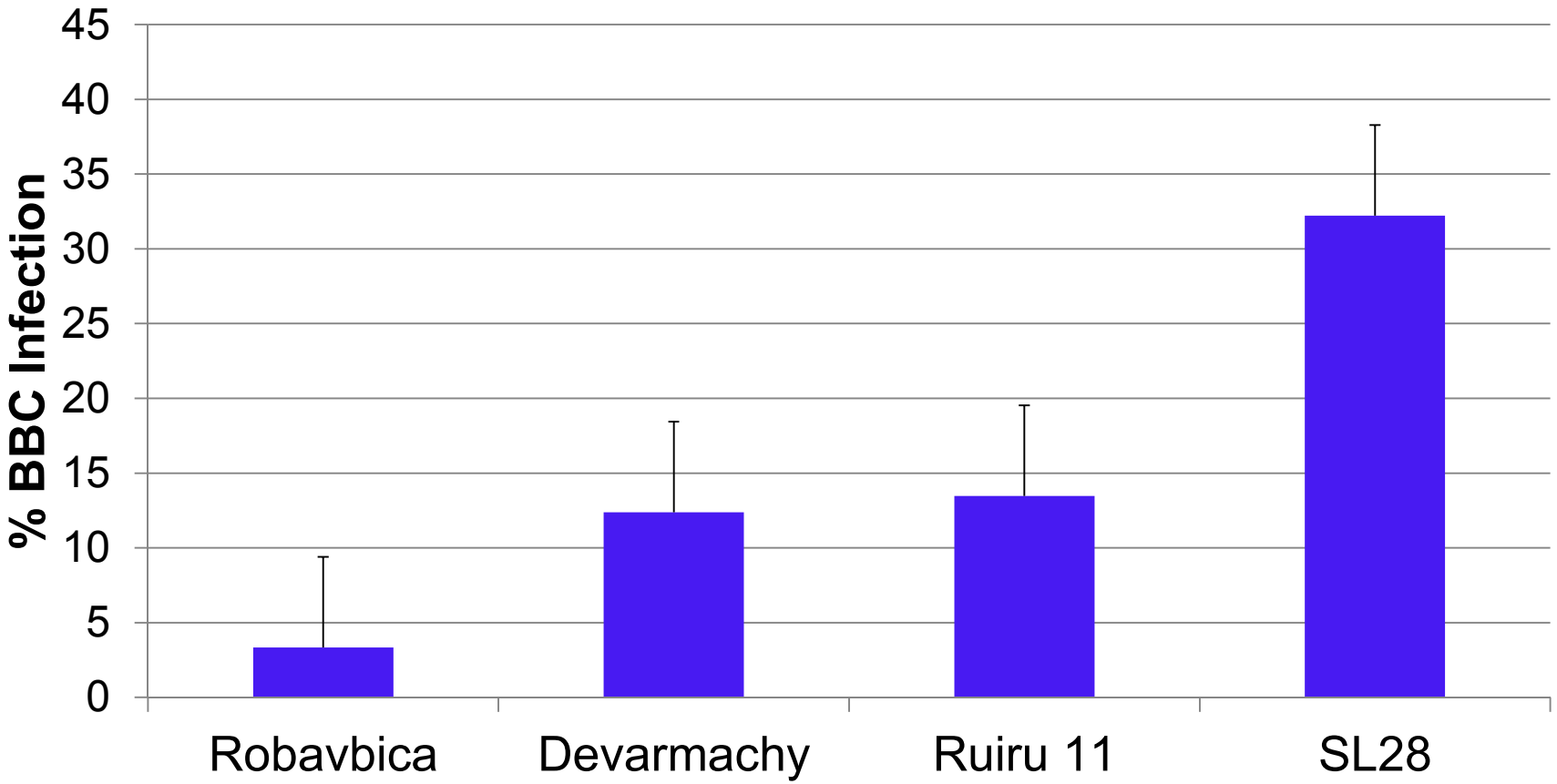
Varietal trials – CLR resistance (Rwanda) – Disease infection



Varietal trials – CLR resistance (Rwanda) - Severity



Varietal trial – additional finding, BBC (Kenya)



Field trials on farm and station – Agronomic data (Zimbabwe)

Variety	Height (cm)	Girth (mm)	No. of primaries
SL28	54.00 a	10.32 a	10.11 a*
Catimor 129	29.28 c	6.84 b	8.00 b
Catimor F6	25.67 c	6.70 b	7.17 bc
Selection 5A	30.33 c	5.95 b	5.44 c
Selection 6	36.06 b	6.57 b	8.83 ab
P	**<.001**	**<.001**	**<.001**

Field trials on farm and station – Agronomic data (Kenya)

Variety	Height	Nodes	Primar.	%BP	LP	Laterals	Berries
CR8	86.07cd	19.33bcd	20.56b	1.35b	54.33a	0.75abcd	0.17b
CR22	86.69bcd	17.89cde	20.33b	3.75b	46.72bcd	0.11d	0.44b
CR23	95.72ab	19.94abc	23.39a	9.06a	49.63abc	0.81abcd	1.81ab
CR27	98.90a	20.50ab	23.16a	1.10b	46.04cde	0.50cd	0.58b
CR30	95.34abc	19.56bcd	23.22a	1.47b	47.60bcd	1.17abc	0.50b
R11	61.21e	14.55f	19.72b	0.46b	41.13e	0.58bcd	0.06b
SL28	87.07bcd	16.83e	23.83a	8.91a	51.49ab	0.94abc	1.53ab
Sln 6 (Robarbica)	98.52a	22.11a	25.56a	10.72a	54.33a	1.36ab	2.97a
Sel 5A (Devamachy)	84.75d	17.39de	23.33a	0.28b	45.06cde	1.50a	0.03b
$LSD_{(5\%)}$	9.459	2.179	2.555	4.369	4.964	0.803	2.09

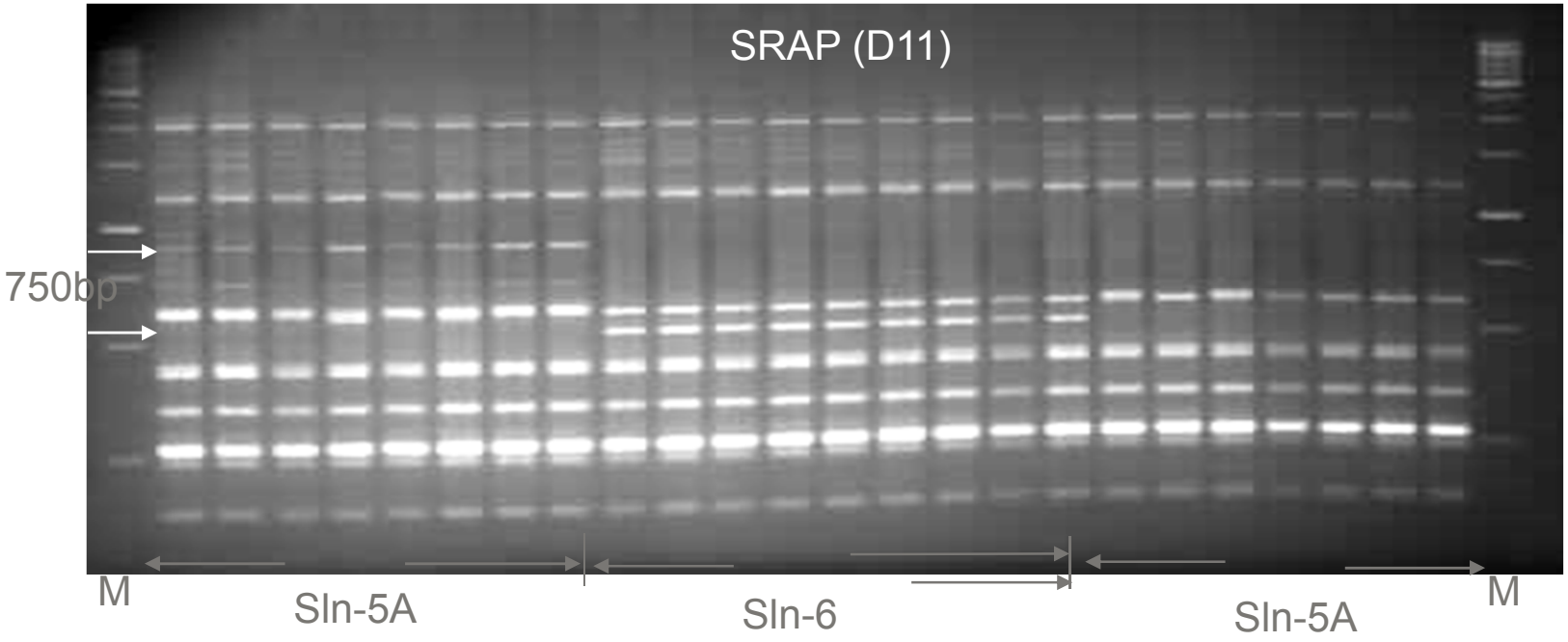
Fungicide trials - Rwanda

Treatment	Gicumbi	Kamonyi	Kayonza	Kirehe	Ngoma	Nyanza	Rusizi	Rutsiro
Cyproconazole (Alto)	4.2	12.8	16.2a	14.9a	16.1a	16.1a	5.4	14.9a
Benomyl (Benlate)	4.4	16.2	31.1b	38.5b	22.0ab	26.1b	8.4	13.2a
Control	3.8	19.4	27.9b	45.8c	26.1b	47.7c	8.7	27.1b
Cop.Oxy.	3.7	14.8	26.5b	33.9b	26.9b	28.8b	5.7	27.1b
Copprt oxychloride (Dacobre)	3.4	15.2	27.2b	35.4b	26.8b	29.5b	7.8	21.8b
Cupric hydroxide (Kocide 101	2.8	18.5	20.9b	32.1b	26.8b	34.4b	7.3	27.7b
Papaya extract	5.3	14.8	23.1b	32.2b		45.9c		
Signific.	*ns*	*ns*	*	*	*	*	*ns*	*ns*

Development of molecular markers for application in coffee breeding

- Molecular marker analysis was carried out using SRAP (Sequence related amplified polymorphism) and RAPD (Random amplified polymorphic DNA) to identify cultivar specific markers
- Ninencultivar specific SRAP primers (one for Sln.5A, five for Sln.6, two for S.795 and one for Chandragiri) were identified
- Similarly, four cultivar specific RAPD primers (two for 5A, one for S.795 and one for Chandragiri) were identified
- The cultivar specific markers have been validated and used to check the homogeneity of the seedling progenies of the improved selections.

Development of molecular markers for application in coffee breeding – validation of markers



Conclusion

- Surveys gave an overview of the coffee leaf rust disease in the participating countries
  - Most varieties in participating countries were susceptible to CLR
  - Albizia, Cordia, Gravillea were the most common shade trees
  - Bananas were also used for shading
- Some CLR races which have been determined are different from country to country in the Eastern and Southern Africa region, hence the need for strengthening quarantine systems is important
- Breeding should incorporate more genes due to the CLR races in the region
- Resistant varieties have been identified in Kenya – registered as Batian
- The introduced Selections (5A and 6) have shown great resistance to CLR
- SIn 6 has shown tolerance to BBC, which will be confirmed under controlled conditions

Conclusion

- Some fungicides are promising, and can be used as a stop gap measure
- Molecular markers have been identified for coffee varieties which can be used in varietal breeding
- Most the work reported here is continuing – more studies such as:
  - Epidemiological studies
  - Cup quality assessment

Acknowledgements

- Partnership institutes: CRF (Kenya), COREC (Uganda), CCRI (India), ISAR (Rwanda), Coffee Research Station (Zimbabwe)
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- Coffee farmers who are participating in the project