

NORTH WEST DEPARTMENT OF AGRICULTURE AND RURAL DEVELOPMENT

AGRICULTURAL DEVELOPMENT SERVICES

**Reaction of common bean germplasm and South African
dry bean cultivars to rust in the field**

**DR HTH MUEDI
NWDARD 2ND AF SYMPOSIUM
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**Agriculture &
Rural Development**
Department:
Agriculture and Rural Development
North West Provincial Government
REPUBLIC OF SOUTH AFRICA



PRESENTATION OUTLINE

1.	Introduction
2.	Materials and Methods
3.	Statistical Analysis
4.	Results and Discussions
5.	Conclusions and Recommendations



INTRODUCTION

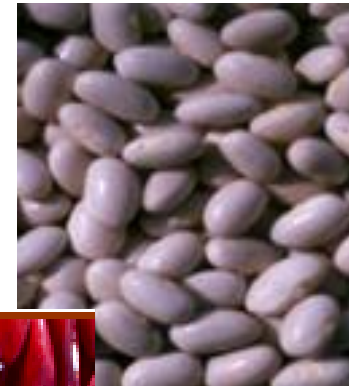
- Dry bean (*Phaseolus vulgaris* L.) is an annual grain crop grown worldwide.
- Popular market types include red speckled (65-75%), small white (10-20%), & dark red kidney beans.



Red
speckled
beans



Dark red
kidney
beans



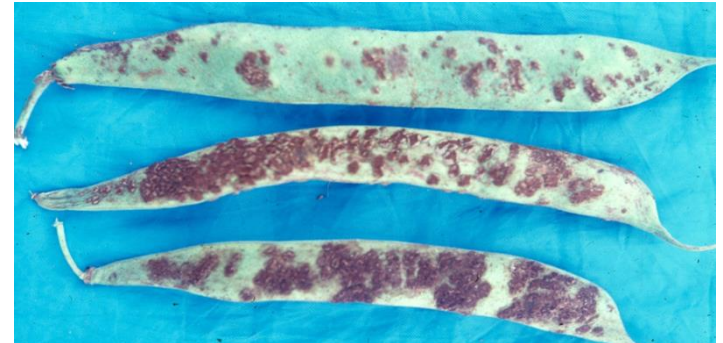
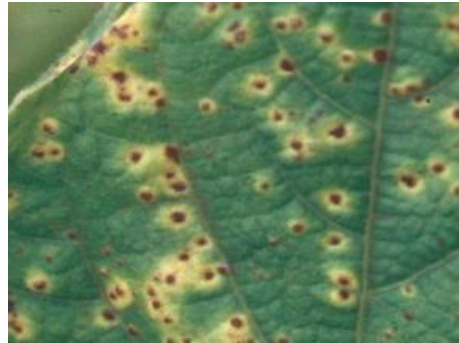
Small
white
beans

Carioca
beans



INTRODUCTION

- Rust is caused by an airborne fungus: *Uromyces appendiculatus*.
- Groups of spores (pustules) are found on leaves, petioles, pods.



- Conditions range from 17 to 21°C, high relative humidity (>95%) for at least 7 to 8 h.
- Yield losses of up to 90% have been reported in RSA.



INTRODUCTION

- Most important dissemination method of bean rust is wind.
- Control measures include sanitation, registered fungicides, crop rotation, & genetic resistance.
- The *Ur-3*, *Ur-4*, *Ur-5* and *Ur-11* RR genes have been identified.
- The objective of the study was therefore to screen selected international common bean germplasm as well as South African commercial dry bean cultivars for reaction to rust in the field to identify rust resistance sources.



MATERIALS AND METHODS

- Thirty-one varieties and twenty-five cultivars.
- Trials were conducted at Cedara (2015/16 and 2016/17 seasons) & Potchefstroom (2015/16 season).
- Planting was either manual or mechanical, in 5 m long 4-row plots, with 75 cm inter-row and 7.5 cm intra-row spacing.
- Trials were arranged in RCBD & replicated three times.



MATERIALS AND METHODS

- A pre-emergence herbicide, Bateleur Gold, was applied.
- Insect pests were controlled using Endosulfan.
- A mixture of four purified rust isolates (R12/01-J, R12/01-M, R13/02-B and R13/02-H) was used to prepare inoculum for Potchefstroom field inoculations.
- The suspension contained approximately 5 g of spores per 20 L of tap water.



MATERIALS AND METHODS

- Disease ratings done at 18 days after inoculation at Potchefstroom.
- Ratings were done during flowering at Cedara.
- Disease severity rating scale of 1-9.
- Trials were harvested manually and yield data recorded.



STATISTICAL ANALYSIS

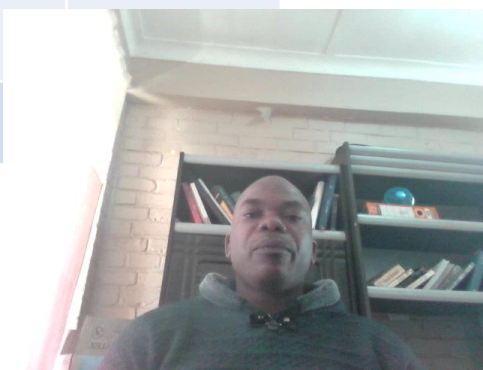
- Data were analysed using GenStat 2017 for windows 19th Edition.
- Analysis of variance (ANOVA) was conducted on disease ratings and yield data.
- Means were separated at LSD ($P \leq 0.05$).
- Correlation coefficients were calculated using Microsoft Excel 2016.



RESULTS

- Table 1. Rust scores on germplasm varieties

Variety	Potch 15/16		Cedara 15/16		Cedara 16/17	
	MR	MS	MR	MS	MR	MS
Mexico 235 (<i>Ur-3</i>)	1	a	1	a	1	a
CAL 143	1	a	1	a	1	a
Flor de Mayo	1	a	1	a	1	a
BelMiNeb-RMR-1	2	c	1	a	1	a
BelMiDak-RMR-10 (<i>Ur-3, 4, 6, 11</i>)	2	c	1	a	1	a
A 240	2	c	2	b	1	a
BelDakMi-RR-19 (<i>Ur-3, 4, 6, 11</i>)	1	a	1	a	1	a
CNC	1	a	1	a	1	a
Montcalm	2	c	3	c	2	
Pinto 114	5	f	6	e	8	



RESULTS

- Table 2. Rust scores on cultivars

Cultivar	Potch 15/16		Cedara 15/16		Cedara 16/17	
	MR	MS	MR	MS	MR	MS
Mkuzi	1	a	1	a	1	a
Kamiesberg	2	ab	1.0	a	1	a
RS7	3	cde	4	efg	5	cd
Teebus-RCR2	1	a	1	a	1	a
Teebus-RR1 (<i>Ur-3</i>)	1	a	1	a	1	a
Sederberg	3	def	4	fgh	5	cd
DBS 310	4	fgh	5	fgh	5	cd
PAN 116	7	j	3	de	6	a
Kranskop (<i>Ur-13</i>)	4	fgh	6	i	5	
Pinto 114	5	i	8	j	8	



DISCUSSION

- The majority of germplasm showed complete resistance (immunity).
- Most of these germplasm varieties contain RR genes that have been characterized before.
- The RR genes work best when stacked.
- RR in BelMiNeb-RMR-10 (*Ur-3, 4, 6, 11*), and CNC has previously been reported in South Africa in the field.



DISCUSSION

- Some cultivars were susceptible.
- These are large seeded and of Andean origin.
- Some are small seeded of Mesoamerican origin.
- Cultivars containing RR genes *Ur-3* & *Ur-13* were resistant & moderately susceptible.
- These findings correlate with that of the dry bean National Cultivar Trials conducted annually in the field in South Africa.



Andean



Mesoamerican



DISCUSSION

- High disease intensity was observed in the two seasons at Cedara (naturally infected trials).
- Allowing for a clearer distinction between the susceptible and resistant reactions.
- Resistant cultivars often react to haustoria formation with a hypersensitive reaction.
- The negative correlations (-0,443 & -0,434) between the rust ratings and yield.



CONCLUSIONS & RECOMMENDATIONS

- Resistance to rust largely exists amongst the germplasm varieties.
- To a lesser extent amongst the commercial cultivars.
- Varieties containing RR genes (*Ur-3*: Mexico 235 & *Ur-11*: BelDakMi-RR-19) were resistant.
- Clear prospects to effectively improve rust resistance.
- It is therefore recommended that more diverse RR genes should be introduced.
- Include Mexico 309 (*Ur-5*), PI 51051, and PI 181996 (*Ur-11*).



THANK YOU



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