Pathotype Variation and Sources of Resistance to the Common Bean Rust Pathogen in Southern Mozambique

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Introduction

Mozambique is a country in which more than 80% of the population practices subsistence agriculture. Most farms are 0.5 to 4.0 hectares where diverse crops are grown using traditional farming methods. Dry bean is cultivated both in monoculture and more often associated with corn during the rainfed season in the north and central regions, and during the cool season with irrigation in the south. Snap beans are planted in succession during the year in the south. The area of bean production is ~370,000 ha (includes other bean species) and the yield is ~750 kg/ha. Both Andean and Middle American origin beans are cultivated, but the majority are Andean types.

One of the major constraints for snap and dry bean production in southern Mozambique is rust caused by *Uromyces appendiculatus* (Pers.) Unger. The consecutive cultivation of beans makes the inoculum of the rust fungus available throughout the year, resulting in high incidence and severity of rust. High pathogenic variability in bean rust has been reported (2). Strategies for bean rust management include fungicides, cultural practices and disease resistance. However, in Mozambique, fungicides are expensive or not available and cultural practice modifications do not fit the cropping systems used. Disease resistance is the most effective and least expensive strategy for the farmers. For developing effective and durable rust resistance, the pathogenic variability of the pathogen needs to be studied. The objectives of this study were to identify pathogenic variability and sources of resistance to bean rust in southern Mozambique.

Materials and Methods

Rust infected bean leaves were collected in 11 bean fields in Chókwe, Chibuto, Maputo, Boane, Namaacha and Moamba regions during the middle growing season (July-August) in 2002. The samples were processed in the greenhouse, in Lincoln, Nebraska during fall-spring, 2002-2003. Field collections of urediniospores were increased on a nearly universal susceptible cultivar Pinto U.I. 114 (P114) and Early Gallatin. Twelve new standard bean differentials were inoculated with each field collection to isolate the single uredinia (pustules). Each single pustule culture was increased on the differential plant from which it was isolated. To avoid pathotype contamination, isolation of the single pustule was done before rupture of the leaf epidermis. If a plant had a mixed rust reaction, the single pustule was reisolated.

Rust inoculum was prepared by suspending 2.5 mg urediniospores in 30 ml of tween 20 solution (40 ul/1000 ml distillate water). Primary leaves of 7-day-old bean plant differentials were uniformly inoculated with each single pustule culture using a hand sprayer. Inoculated plants were put in a mist chamber at 100% RH and 21 ± 1°C for ~16 hours before placing in the greenhouse at 22 ± 2°C. The inoculation process was repeated twice. Disease reaction (urediniun size measured with a hand lens) was recorded using 1-6 standard grading scale 14 days after inoculation. The scale was converted to 1.1 - 6.1 quantitative disease score (1) and then assigned resistant, intermediate and susceptible reactions (Table 1).

Results and Discussion

A total of 69 pathotypes of *U. appendiculatus* were identified on the 12 bean differential lines/cultivars and the susceptible P114. Reaction on P114 was included because the virulence of isolates from the same field collection on this cultivar often differed from the reaction on the 12 differentials. Most of the Andean lines with resistance genes were susceptible to these isolates, and Montcalm showed a susceptible reaction to all isolates. However, Redlands Pioneer showed a resistant reaction to 34 isolates (49%) (Table 1). Most of the varieties cultivated in southern Mozambique are susceptible and are Andean origin beans. Genes from Middle American origin were resistant to most of the isolates (Table 1). The Ur-11 gene was resistant (no sporulation) to all 69 isolates. Ur-3, Ur-5 and Ur-11 rust resistance genes were also reported to be useful sources of resistance to rust pathogen populations from South Africa (2).

Conclusion

The Middle American beans provide resistance genes for rust from southern Mozambique. For variety development, one or more of the Middle American Ur-3, Ur-5, Ur-11 genes and the unknown gene of CNC should be incorporated into adapted germplasm as sources of resistance to the common bean rust pathogen.

Table 1. Reaction of bean differential cultivars to 69 rust isolates from southern Mozambique

Bean cultivar/ line	Gene pool *	Resistance gene	% resistant reactions	** Reaction to isolates		
				Resistant	Intermediate	Susceptible
1.Early Gallatin	A	Ur-4	6	4	0	65
2.Red-Pioneer	A	Unknown	49	34	24	11
3.Montcalm	A	Unknown	0	0	0	69
4.PC 50	A	Ur-9, Ur-12	13	9	48	12
5.GGW	A	Ur-6	29	20	22	27
6.PI 260418	A	Unknown	3	2	52	15
7.GN 1140	MA	Ur-7	29	20	22	27
8.Aurora	MA	Ur-3	90	62	2	5
9.Mex 309	MA	Ur-5	93	64	3	2
10.Mex 235	MA	Ur-3+	94	65	2	2
11.CNC	MA	Unknown	93	64	4	1
12.PI 181996	MA	Ur-11	100	69	0	0

* Gene pool: A=Andean, MA=Middle American. GGW=Golden Gate Wax; CNC=Compuesto Negro Chimaltenango.
** Grading scale: Resistant, grade 1.1 - 3.1; Intermediate, grade 3.4 - 4.1; Susceptible, grade 4.4 - 6.1.

References

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