IDENTIFICATION OF SSR MARKERS LINKED TO RUST RESISTANCE IN ANDEAN COMMON BEAN PI 260418

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INTRODUCTION

Bean rust is a major disease of common bean that reduces yields and increase costs of dry and snap bean production in many parts of the world. Disease resistant cultivars offer the most effective, economical, and environmentally-friendly method of controlling bean rust. However, this strategy is complicated by the high virulence diversity of the rust pathogen *Uromyces appendiculatus*. Many races of this pathogen have been identified and reported in all bean production areas of the world. Conversely, several rust resistance genes have been identified and characterized in common bean. All of these genes so far identified and published are dominant. Some of these genes, such as *Ur-3*, *Ur-5*, *Ur-7*, and Ur-*11*, as well as unnamed genes *Ur-Dorado 108*, *Ur-Ouro Negro*, *Ur-BAC 6*, and *Ur-Dorado 53*, are from Mesoamerican bean genotypes, while other genes, such as *Ur-4*, *Ur-6*, *Ur-9*, *Ur-12*, and *Ur-13*; as well as unnamed genes *Ur-US#3* (*Ur-8*), *Ur-Resisto* (*Ur-10*) are from bean genotypes of the Andean gene pool. Invariably, rust resistance genes from the Mesoamerican gene pool have a broader spectrum of resistance than genes from the Andean gene pool. For instance Mesoamerican genes *Ur-3*, *Ur-5*, and *Ur-11* are resistant to 44, 70, and 89 races respectively, while *Ur-4* and *Ur-6* are resistant to 30 and 22 races respectively, of 90 races of the rust pathogen maintained at the USDA-ARS Bean Project in Beltsville, MD (Stavely, 2000). PI 260418 (collected in Bolivia) is the first Andean common bean with resistance to all but one of the same 90 races of the same bean rust pathogen mentioned above (Table 1). PI 260418 is susceptible only to Andean race 84 which was collected from an Andean bean in Colorado. The reaction of PI 260418 to the 90 races of the rust pathogen resembles the reaction of PI 181996 (*Ur-11*) which is also resistant to all but one race (Mesoamerican race 108) of the same 90 races mentioned above. We have studied the inheritance of rust resistance in PI 260418 and now we endeavor to find molecular markers linked to this resistance for use in marker-assisted selection. Microsatellite markers are PCR-based markers that have been developed for a wide variety of plant species including commercial crops. Microsatellites detect length polymorphisms at genetic loci that have simple sequence repeats (SSR). The objective of this study was to identify molecular markers linked to the rust resistance gene or genes present in PI 260418. These markers will be very useful in the introgression of this new rust resistance into dry and snap bean cultivars.

MATERIALS AND METHODS

An F_2 population (2-3773, 120 plants) from the cross Pinto 114 x PI 260418 was inoculated with four races of the rust pathogen; two Andean races (98 and 99) and two Mesoamerican races (63 and 85). Pinto 114 was susceptible and PI 260428 was resistant, respectively to all four races. DNA was extracted from 94 F_2 plants. Many primers (more 1300) were evaluated to identify those that were polymorphic between the two parents. Primers evaluated included published (146) and unpublished (278) bean primers, ESTs (174), soybean (715) and *Medicago truncutula* (4) primers.

RESULTS AND DISCUSSION

A total of 158 primers were polymorphic between Pinto 114 and PI 260418. Of the 715 soybean primers evaluated, only 90 produced amplification products but none were polymorphic between the two parents. Bean SSR primer pairs derived from bean genomic DNA sequences were more likely to produce amplification products (72%) than primers pairs from EST sequences (59%). About 28% of the SSR primers derived from genomic sequences detected polymorphisms between the two parents. We identified two single sequence repeats (SSR) markers closely linked to the region that confers resistance to the rust isolates used in this study. These markers were linked at a genetic distance of 20 cM (Figure 1). In addition these two SSR markers were closely linked to two other rust resistance loci.

REFERENCES

Stavely, J.R. 2000. Pyramiding rust and viral resistance genes using traditional and marker techniques in common bean. Ann. Rep. Bean Improv. Coop. 43: 1-4.

Table 1. Reaction of Andean bean PI 260418 and other Andean and Mesoamerican cultivars to selected Andean and Mesoamerican races of pathogen *Uromyces appendiculatus*

Andean (yellow) and Mesoamerican (blue) bean Cultivars	Resist. Gene	Reaction to Andean and Mesoamerican races of the rust pathogen												
		Mesoamerican							Andean					
		41	44	47	49	53	73	108	38	72	84	89	98	102	105
PI 260418		R	R	R	R	R	R	R	R	R	S	R	R	R	R
Early Gallatin	*Ur-4*	S	R	S	R	S	R	R	S	S	S	S	S	S	S
Redlands Pioneer		S	S	S	S	S	S	R	R	R	R	R	R	R	R
Pompadour Checa 50	*Ur-9*	S	R	S	R	S	R	R	R	R	R	R	R	S	S
Golden Gate Wax	*Ur-6*	R	R	R	S	S	R	S	R	S	R	S	S	S	S
Great Northern 1140	*Ur-7*	S	R	S	R	S	S	R	R	R	S	R	R	R	R
Aurora	*Ur-3*	R	S	S	S	R	S	R	R	R	R	R	R	R	R
Mexico 235	*Ur-3+*	R	S	R	R	R	S	R	R	R	R	R	R	R	R
Mexico 309	*Ur-5*	R	R	R	S	R	S	S	R	R	R	R	R	R	R
PI 181996	*Ur-11*	R	R	R	R	R	R	S	R	R	R	R	R	R	R

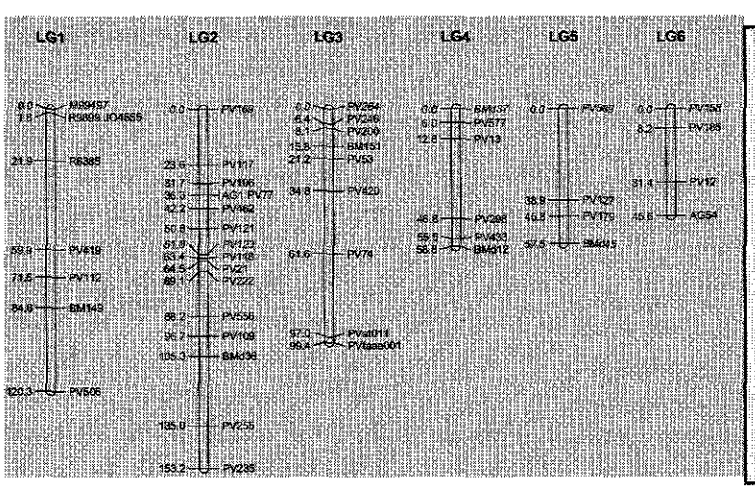

Figure 1. We identified two single sequence repeats (SSR) markers in linkage group (LG) 1 closely linked to the region that confers resistance in Andean bean PI 260418 to the rust isolates used in this study. These two SSR markers were linked at a genetic distance of 20 cM (Figure 1). In addition these two SSR markers were closely linked to two other rust resistance loci.