

Cultivar and Germplasm Release

RELEASE OF 'BENÍQUEZ' WHITE BEAN (*PHASEOLUS VULGARIS* L.) CULTIVAR¹

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A major objective of the bean breeding program at the University of Puerto Rico has been the development and release of white bean (*Phaseolus vulgaris* L.) cultivars with resistance to viral diseases. *Bean golden yellow mosaic virus* (BGYMV), a whitefly [*Bemisia tabaci* (Gennadius)]-transmitted begomovirus, can cause significant reduction in common bean seed yield when susceptible bean cultivars are planted in Central America and the Caribbean (Coyné et al., 2003). Bean common mosaic virus (BCMV) is a seed-borne disease that can also cause yield loss in susceptible cultivars (Beaver and Osorno, 2009). Recently released bean cultivars in Puerto Rico, including 'Morales' (Beaver and Miklas, 1999) and 'Verano' (Beaver et al., 2008), have the *bgm-1* and *I* resistance genes and the SW12 QTL that provide resistance to BGYMV and BCMV. Unfortunately, bean common mosaic necrosis virus (BCMNV), which arrived in the Dominican Republic and Haiti during the past decade, can cause a top necrosis reaction in bean cultivars that have an unprotected *I* gene (Beaver et al., 2003). Bean lines that possess the dominant *I* and the recessive *bc-3* genes have resistance to all known strains of BCMV and BCMNV (Kelly et al., 1994).

Origin

'Beníquez', a multiple disease-resistant white bean adapted to the humid tropics, was developed and released cooperatively by the Puerto Rico (UPR) and Nebraska (UNL) Agricultural Experiment Stations, the USDA-ARS, and the Instituto Dominicano de Investigaciones Agropecuarias y Forestales (IDIAF). 'Beníquez' has resistance to BGYMV, BCMV, BCMNV and bean rust caused by *Uromyces appendiculatus* (Pers.) Unger. 'Beníquez' (UPR breeding line PR0442-28) was derived from the cross PR0003-124/Raven'. PR0003-124 is a white bean line derived from the cross DOR483/BeINeb RR-2//MUS83/DOR483 that was selected in Puerto Rico for resistance to BGYMV and root rot, and for tolerance to high temperature stress. Results from screening with the SR2 (Blair et al., 2007) and SW13 (Melotto et al., 1996) SCAR markers support the hypothesis that PR0003-124 has the *bgm-1* gene (Vélez et al., 1998) for resistance to

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BGYMV, and the *I* gene for resistance to BCMV. Line PR0003-124 also has the SW12 QTL (Miklas et al., 2006) for resistance to BGYMV. 'Raven', a black bean cultivar developed and released by the Michigan Agricultural Experiment Station, has an erect habit and the *bc3* gene for resistance to BCMNV (Kelly et al., 1994). 'Raven' was selected for adaptation to the tropics as a breeding line in the Michigan State dry bean winter nursery conducted at Isabela, Puerto Rico.

The F_1 nursery was planted at the UPR Isabela Substation in October 2000. Individual plants having desirable agronomic traits and white seed were selected from the F_2 nursery. The $F_{2,3}$ lines were screened in the greenhouse at the UPR Mayagüez Campus for the presence of the SCAR marker SR-2 linked to the *bgm-1* gene for resistance to BGYMV. The $F_{3,4}$ line XRAV 14-8 was screened in the greenhouse during the summer of 2002 at the UNL with rust races from the Dominican Republic and Haiti (DR01-2-P114, DR02-11-10, DR011-12, HT9947, HT9947 4 PC50, and HT-991P131160), and this line was found to have resistant reactions. Line XRAV 14-8 was also screened at the UNL during the summer of 2002 for BCMNV reaction, using the NL3 and NL8 strains. The inoculated plants of the line XRAV 14-8 did not develop symptoms to the virus. The presence of the SCAR marker SW13 suggests that this line combined the *I* and *bc-3* genes for resistance to BCMV and BCMNV. The $F_{4,5}$ generation was screened in the field in the Dominican Republic in a trial planted at San Juan de la Maguana in November 2002. The bean lines at this site were exposed both to BGYMV and to the NL8 strain of BCMNV that were present at this site. Lines that did not develop symptoms of these viral diseases were selected. Pedigree selection was used in Puerto Rico in 2004 to select individual plants from F_6 plant rows. The seed of line PR0442-28 was bulked in the F_7 generation.

Line PR0442-28 was screened again at the USDA-ARS Tropical Agriculture Research Station laboratory with SCAR markers and was found to have the SR2 marker for the *bgm-1* gene (Vélez et al., 1998), the SW12 QTL for BGYMV resistance (Miklas et al., 2000) and the SW13 marker for the *I* gene for BCMV resistance (Melotto et al., 1996). Line PR0442-28 was also mechanically inoculated in a greenhouse at the University of Puerto Rico Mayagüez Campus with the NL3 strain to confirm resistance to BCMNV. Line PR0442-28 is resistant to bean rust races endemic to Puerto Rico. Line PR0442-28 had susceptible reactions when inoculated at the USDA-ARS Tropical Agriculture Research Station with the 3353 and 484A strains of the common blight pathogen *Xanthomonas axonopodis* pv. *phaseoli* (Smith) Vauterin et al.

'Beníquez' (PR0442-28) has an indeterminate upright Type II growth habit. 'Beníquez' initiates flowering at approximately 33 d, and reaches harvest maturity 83 d after emergence. 'Beníquez' has a white seed with an average weight of 23 g/100 seed. Seed size and shape are acceptable for green-shelled bean production in Puerto Rico.

The performance of 'Beníquez' was evaluated in 10 field trials conducted at the Isabela Substation from 2006 to 2010. 'Beníquez' produced seed yields similar to those of the check cultivars 'Morales' and 'Verano' (Table 1). The production of 'Beníquez' is recommended during the winter months when dry weather does not favor the development of common blight. The resistance that 'Beníquez' demonstrated to the virulent Dominican and Haitian rust races increases the likelihood that the cultivar will have resistance to this important disease in the Caribbean region.

The release of 'Beníquez' provides bean producers in Puerto Rico with some insurance against the potential emergence of BCMNV. It should be noted, however, that the almost universal use of bean cultivars with the unprotected *I* gene also helps to prevent the spread of BCMNV on the island.

Availability of Seed

Small quantities of breeder seed may be obtained from the first author. Plant variety protection will not be sought for this cultivar.

TABLE 1. Performance of the white-seeded bean line PR0442-28 ('Beniquez') compared with check (ck) cultivars in field trials planted at Isabela, Puerto Rico from 2006 to 2010.

Line	Pedigree	Seed yield (kg/ha)											
		June 2006	Nov 2006	Dec. 2006	Nov. 2007	Nov. 2008	Feb. 2009	Nov. 2009	Jan. 2010	Oct. 2010	Nov. 2010	Mean	
'Beniquez'	PR0003-124 / 'Raven'	1,902	1,812	3,016	2,420	2,956	2,068	1,633	1,297	2,736	2,840	2,268	
'Morales' (ck)		1,453	2,010	2,958	2,031	2,782	2,418	1,926	1,078	3,022	2,114	2,179	
'Verano' (ck)						2,733	1,919	1,824	1,063	2,895	2,354	2,131	
Mean		1,531	1,737	2,455	2,008	2,394	1,826	1,455	812	2,536	2,155	2,107	
LSD (0.05)		603	455	407	368	420	551	494	365	782	452		
CV (%)		34.1	22.8	14.4	21.8	14.0	23.1	27.1	36.0	24.6	16.8		

