Registration of 'Croissant' Pinto Bean

Mark A. Brick,* James B. Ogg, Howard F. Schwartz, Jerry J. Johnson, Fred Judson, Shree P. Singh, Phillip N. Miklas, and Marcial A. Pastor-Corrales

ABSTRACT

'Croissant' (Reg. No. CV-299, PI 656597), a new medium-maturity (92–98 d) pinto bean (*Phaseolus vulgaris* L.) cultivar was released by the Colorado Agricultural Experiment Station to provide dry bean producers in the USA with a high-yielding cultivar that combines resistance to rust [caused by *Uromyces appendiculatus* (Pers.) Unger], most strains of *Bean common mosaic virus* (BCMV) and *Bean common mosaic necrosis virus* (BCMNV), and field resistance to common bacterial blight (CBB) [caused by *Xanthomonas axonopodis* pv. *phaseoli* (Smith) Vauterin et al.; Synonym: *X. campestris* pv. *phaseoli* Smith (Dye)]. Croissant has an indeterminant growth habit with semi-upright plant architecture (Type IIb) in most environments; however, in environments with high soil N and moisture it can express semi-vine architecture (Type IIIa). Resistance to rust is conditioned by the *Ur-3* (Middle American) and *Ur-6* (Andean) dominant alleles, and resistance to BCMV and BCMNV is conditioned by the recessive allele *bc-2*^{2}. Croissant possesses the SAP6 marker linked with a quantitative trait locus (QTL) that confers a moderate level of field resistance to CBB endemic to the High Plains of the USA. In 2008 and 2009, the mean seed yield for Croissant was 3102 and 2895 kg ha^{-1} and the mean seed weights were 36.2 and 36.3 g/100 seed compared with 3142 and 3095 kg ha^{-1} and 38.2 and 37.7 g/100 seed for the mean of five test entries, respectively. Croissant is unique to other recent upright architecture pinto cultivars because it possesses two genes for resistance to rust and the SAP6-linked QTL to provide a moderate level of resistance to CBB.

Pinto bean is the largest market class of dry edible beans produced in the USA. In 2009 pinto bean production was 4872 metric tons and constituted 43% of all dry bean production in the USA (USDA-NASS, 2010). In the western region and High Plains of the USA, pinto beans are widely grown and exposed to many diseases and environmental stresses that can cause crop loss (Stavely and Pastor-Corrales, 1989; Brick and Grafton, 1999; Cook et al., 2004). Until recently, most pinto bean producers in these regions grew cultivars with a growth habit Type III, semi-vine (Singh, 1982) planted at row spacings of 76–92 cm. The mean seed yield for pinto beans in the USA has increased only modestly during the past 20 yr, in part because cropping systems have not changed to accommodate the new upright cultivars. The mean seed yield for pinto bean in the USA from 2007 to 2009 was 1905 kg ha^{-1} compared with 1560 kg ha^{-1} from 17 to 19 (USDA-NASS, 2010). The 2007–2009 yield represents an increase of approximately 17 kg ha^{-1} yr^{-1}, or less than 1% per year during the 20-yr period. There is a need to seek alternative cultural practices to improve the seed yield of the common bean.

Recently, pinto bean producers have started to explore new production practices that have the potential to increase yield and permit direct harvest systems, which reduce the number of field operations and the cost of production (Smith, 2004). These cultural practices include narrow-row spacing (<75 cm between rows) and the use of upright-growth-habit Type II cultivars. Genes that condition the Type II upright growth habit were initially introgressed into determinate Type I cultivars to improve plant type and seed yield in small-seeded, indeterminate Central American cultivars (Adams, 1982). More recently, the Type II growth habit has been introgressed into germplasm of the Durango race (Singh et al., 1991) to reduce the incidence of foliar diseases because the Type II growth habit enhances air flow in the canopy. An upright growth habit can reduce production costs because such architecture lends itself to direct-harvest systems (Kelly and Adams, 1987; Singh, 2001; Smith, 2004). Breeders have recently responded to the need

M.A. Brick, J.B. Ogg, and J.J. Johnson, Dep. of Soil and Crop Sciences, Colorado State Univ., Ft. Collins, CO 80523; H.F. Schwartz, Dep. of Bioagricultural Sciences and Pest Mgmt., Colorado State Univ., Ft. Collins, CO 80523; F. Judson, Western Colorado Research Station, 3168 B 1/2 Rd., Grand Junction, CO 81503-9621; S.P. Singh, Univ. of Idaho, 3793 N 3600 E, Kimberly, ID 83341-5076; P.N. Miklas, USDA-ARS, Prosser, WA 99350; M.A. Pastor-Corrales, USDA-ARS, Soybean Genomics and Improvement Lab., Building 006, Plant Sciences Institute, Beltsville Agricultural Research Center, Beltsville, MD 20705-2350. Registration by CSSA. Received 29 July 2010. *Corresponding author (Mark.Brick@Colostate.edu).

Abbreviations: BCMV, *Bean common mosaic virus*; BCMNV, *Bean common mosaic necrosis virus*; CBB, common bacterial blight; CDBN, Cooperative Dry Bean Nursery; MRPN, Midwest Regional Performance Nursery; QTL, quantitative trait locus; WRBT, Western Regional Bean Trial.

Published in the Journal of Plant Registrations 5:299–303 (2011).
doi: 10.3198/jpr2010.07.0443crc
Posted online 26 Apr. 2011.

5585 Guilford Rd., Madison, WI 53711 USA

for upright architecture in pinto beans by releasing such cultivars as 'Lariat', 'Stampede' (Osorno et al., 2010a), 'ND-307' (Osorno et al., 2010b), and 'Santa Fe' (Kelly et al., 2010). By combining the upright growth habit with resistance to multiple diseases, growers should be able to increase the yield potential and reduce input costs, thereby remaining economically competitive with other crops used in their rotation (Miller et al., 2004), such as maize (*Zea mays* L.) and wheat (*Triticum aestivum* L.).

Improved cultivars of dry beans must possess resistance to multiple diseases to reduce dependence on pesticides and protect the environment. Three major diseases that affect dry bean production in the western USA and High Plains are foliar rust [caused by *Uromyces appendiculatus* (Pers.) Unger], *Bean common mosaic virus* (BCMV) and *Bean common mosaic necrosis virus* (BCMNV), and common bacterial blight (CBB) [caused by *Xanthomonas axonopodis* pv. *phaseoli* (Smith) Vauterin et al.; Synonym: *X. campestris* pv. *phaseoli* (Smith) Dye]. Resistance to these pathogens in combination with the Type II upright architecture will reduce the dependence on pesticides for economically viable bean production. The rust pathogen comprises many strains that may vary from year to year and/or from location to location and are categorized into races by their virulence on specific genotypes of common bean (Stavely et al., 1992). Control of rust is most economically and efficiently done by genetic resistance, and it is best to pyramid genes from both the Middle American and Andean gene pools to provide longer-term, stable protection (Pastor-Corrales and Stavely, 2002). 'Croissant' (Reg. No. CV-299, PI 656597), which was developed by the Colorado Agricultural Experiment Station, will provide dry bean producers with a pinto cultivar that has medium-season maturity (92–98 d); high yield potential; excellent pinto seed quality; resistance to rust, BCMV, BCMNV, and CBB; and adaptation to the middle and northern latitudes in the USA.

Methods

Croissant, which was tested as CO 23704, was derived from a single $F_{4:5}$ plant selected in 2001 from the pedigree 'BelDakMi-RR-3'/CO 07010-2//WM2-93-5. BelDakMi-RR-3 (Stavely et al., 1994) is a pinto breeding line released by the USDA-ARS, Beltsville, MD that has resistance to common bean rust and carries the *Ur-6* (Andean) and *Ur-11* (Middle American) dominant alleles for resistance to specific races of this pathogen. CO 07010-2 is an experimental pinto breeding line from the Colorado State University Breeding Project with the pedigree 'NW410'/'Roza'//XAN125. NW-410 (Burke, 1982a) is a pinto bean cultivar released jointly by the USDA-ARS and the agriculture experiment stations of Washington State University, University of Idaho, Oregon State University and Colorado State University. NW-410 combines short stature and high-yielding plant architecture with early maturity and resistance to Fusarium root rot [caused by *Fusarium solani* (Mart.) Appel & Wr. f. sp. *phaseoli* (Burk.) Snyd. & Hans]; to some strains of BCMV; and to *Beet curly top virus*. Roza (Burke, 1982b) is a pink bean cultivar released jointly by the ARS-USDA and the agricultural experiment stations of Washington State University and University of Idaho; it has resistance to some strains of BCMV and Fusarium root rot. XAN125 is an experimental line (unknown pedigree) from the International Center for Tropical Agriculture (CIAT), Cali, Colombia. XAN 125 has an indeterminate, upright growth habit Type II with small white seeds (navy), *I*-gene resistance to BCMV, and field resistance to CBB (SAP6 marker). CO 07010-2 has semi-upright architecture and excellent pinto seed quality. WM2-93-5 is an experimental pinto breeding line obtained from Dr. Dermot Coyne, University of Nebraska, Lincoln, NE, that possesses resistance to strains of rust endemic to Colorado conditioned by *Ur-3*, field resistance to CBB conditioned by a quantitative trait locus (QTL) linked to the SAP6 marker (Miklas et al., 2003), and semi-upright Type II architecture.

The final hybridization of parental lines was made at Colorado State University, Fort Collins, CO, in 1997. Pedigree selection was conducted on the F_2–F_5 generations at the Agricultural Research, Demonstration, and Education Center, Fort Collins, CO. The original material that led to the cultivar Croissant was a single $F_{4:5}$ plant selected in 2001 and grown as a progeny row in 2002. In 2002 the progeny row was bulked and grown at Fort Collins for testing in 2003 and 2004. In 2004, 35 plants that expressed uniformity for plant habit, maturity, seed quality, and resistant reaction to common bean rust were selected and grown in the greenhouse during winter 2004–2005 for clean seed increase and purification. During summer 2005, the 35 selected plants were planted in rows at Fruita, CO, and 25 of the 35 plant rows were selected based on uniformity for maturity, seed quality, and growth characteristics then bulked to form the original breeder seed source for Croissant and all subsequent out-of-state and regional testing.

From 2007 to 2009, Croissant was tested in replicated trials by the Colorado State University Crops Testing Program at multiple locations in Colorado. Croissant was also tested in four states (Colorado, Nebraska, North Dakota, and Michigan) in the Midwest Regional Performance Nursery (MRPN) and in four states (Colorado, Idaho, Nebraska, and Washington) in the Western Regional Bean Trials (WRBT) in 2006 and 2007. Croissant was tested in the Cooperative Dry Bean Nurseries (CDBN) at 11 and 10 locations in 2008 and 2009, respectively. Replicated experimental units for each location varied but usually consisted of four-row plots at least 6 m in length. Data reported from the MRPN and CDBN nursery do not include LSD values appropriate to the grand mean of entries across locations (as reported in Tables 1 and 2). Consequently, to calculate an appropriate LSD for the grand means, the LSD values for each location were averaged then multiplied by $\sqrt{1/n}$, where n = number of locations reporting the LSD, to make them appropriate for comparisons among the grand means.

Characteristics

Croissant was released to provide bean growers in the USA a high-yielding pinto cultivar that combines resistance to common rust and endemic strains of BCMV and BCMNV, field resistance to CBB, and semi-upright Type II architecture.

Seed Yield and Seed Weight

The seed yield of Croissant was compared with four test cultivars, the newly released upright pinto bean cultivars Stampede, Lariat, and Santa Fe and the check cultivar 'Othello' (Burke et al., 1995), in the CDBN in 2008 and 2009 (Table 1). The mean seed yields for Croissant were 3102 and 2895 kg ha^{-1} in 2008 and 2009, respectively, compared with 3142 and 3095 kg ha^{-1} for the means of all five entries, including Croissant. The mean seed weights for Croissant were 36.2 and 36.3 g/100 seed, compared with the means of 38.2 and 37.7 g/100 seed for all five cultivars in 2008 and 2009, respectively. In the MRPN, the mean seed yield for Croissant was 2940 and 2902 kg ha^{-1} compared with 2979 and 2718 kg ha^{-1} for the five entries during 2006 and 2007, respectively (Table 2). Mean seed weights were 38.2 and 37.1 g/100 seed for Croissant, compared with 40.1 and 38.4 g/100 seed for the mean among these entries in 2006 and 2007, respectively. In the Western Regional Bean Trials (WRBT), mean seed yields for Croissant over four locations were 2169 and 3221 kg ha^{-1} compared with 1842 and 2888 kg ha^{-1} for the mean of 14 to 16 pinto breeding lines tested in 2006 and 2007, respectively (data not shown). Seed size in the same trials was 37.0 and 36.3 g/100 seed, respectively, for Croissant compared with the trial mean of 38.1 and 37.1 g/100 seed, respectively.

Table 1. Seed yield, seed weight, and harvest maturity of selected upright Type II pinto bean cultivars tested in the Cooperative Dry Bean Nursery in 2008 (11 locations) and 2009 (10 locations).†

	2008			2009		
Cultivar	Yield	Seed weight	Harvest maturity	Yield	Seed weight	Harvest maturity
	kg ha^{-1}	g/100 seed	d	kg ha^{-1}	g/100 seed	d
Croissant	3102	36.2	104	2895	36.3	98
Lariat	3227	39.4	115	3374	39.4	101
Othello	3094	39.3	87	2961	36.7	91
Santa Fe	3075	39.4	108	3101	40.4	98
Stampede	3216	36.6	106	3145	35.9	99
Mean	3142	38.2	104	3095	37.7	97
LSD ($P \le 0.05$)‡	207	1.4	1.9	191	0.9	1.2

†Data reported from the 2008 and 2009 Cooperative Dry Bean Nursery Report, compiled and summarized by Dr. Phillip Miklas, USDA-ARS, Prosser, WA.

‡LSD ($P \le 0.05$) based on pooled values across locations in 2008 (n = 11) and 2009 (n = 10).

Table 2. Seed yield, seed weight, and days to harvest maturity of selected upright Type II pinto bean cultivars tested in the Midwest Regional Performance Nursery in 2006 and 2007.†

	2006			2007		
Cultivar	Yield	Seed weight	Harvest maturity	Yield	Seed weight	Harvest maturity
	kg ha^{-1}	g/100 seed	d	kg ha^{-1}	g/100 seed	d
Croissant	2940	38.2	48	2902	37.1	100
Lariat	3309	42.2	46	2597	38.8	102
ND 307	3104	41.5	45	2742	38.1	101
Santa Fe	NT‡	NT	NT	2396	40.9	98
Stampede	3061	39.9	45	2952	37.3	97
Mean	2979	40.1	46.3	2718	38.4	99.6
LSD ($P \le 0.05$)§	262	1.4	1.6	268	1.9	1.7

†Data reported from the 2006 and 2007 Midwest Regional Performance Nursery, data compiled and summarized by Dr. Ken Grafton, NDSU, Fargo, ND.

‡NT, not tested.

§LSD ($P \le 0.05$) based on pooled values across locations in 2006 (n = 3) and 2007 (n = 4).

Disease Resistance

Croissant possesses the recessive *bc-2²* gene for resistance to the seed-borne BCMV and BCMNV strains NL-3 and NL-8 (Table 3). When infected with NL-3, Croissant expresses a symptomless reaction. Croissant is resistant to all NL strains of BCMV except NL-4 (aka US-6), which will show a susceptible reaction with typical light and dark-green mosaic symptoms.

Croissant possesses a moderate level of field resistance to CBB due to the presence of the SAP6 SCAR molecular marker linked to a major QTL that provides resistance. This QTL is derived from the great northern landrace Montana No. 5 (Miklas et al., 2003; Mutlu et al., 2005). We think that SAP6 in Croissant was inherited from the parent WM2-93-5, a breeding line obtained from Dr. Dermot Coyne, University of Nebraska, or XAN-125, a breeding line from CIAT, Cali, Colombia. The presence of SAP6 was confirmed by a SCAR marker linked to the QTL. The QTL linked to SAP6 confers a moderate level of field resistance to

Table 3. Disease and seed characteristics of Croissant compared with those of recently released upright pinto bean cultivars in the USA.

		Cooking and canning qualities			Common bean rust reaction†		
Cultivar	BCMNV‡	Variation in size	Uniformity of color	Appearance§	Race 53	Race 47	Race 73
		0–2¶					
Croissant	R#	1.50	1.25	0.88	R	R	R
Lariat	R	1.25	1.13	1.25	R	S	S
Santa Fe	R	1.50	1.38	0.5	R	S	S
Stampede	R	1.00	0.00	0.38	R	S	S
Othello	R	1.50	0.63	0.88	S	S	S

†Common bean rust reaction based on greenhouse tests for Croissant; other cultivar reactions based on published allele composition in JPR release statements.

‡BCMNV, *Bean common mosaic necrosis virus* strains NL-3 and NL-8.

§Based on visual rating for freedom from seed splits in the canned product.

¶0 = very poor; 1 = acceptable; 2 = premium.

#R, resistant; S, susceptible.

CBB (Miklas et al., 2006); however, the intermediate reaction seen in the field is often reduced to a susceptible reaction under a more severe greenhouse test. Croissant was rated 3.5 (on a scale of 1 to 9, with 1 = most resistant, and 9 = susceptible) compared with 6.3 among 15 pinto genotype means in the WRBT in 2007 under inoculated field conditions. However, when tested in the more severe greenhouse test, Croissant was rated as being susceptible (9). Croissant is susceptible to races 7 and 73 of the anthracnose-causing fungus *Colletotrichum lindemuthianum* (Sacc. & Magn.) Lams.-Scrib. based on greenhouse tests.

Croissant is resistant to prevalent races of the common bean rust pathogen in the High Plains and western USA. When challenged with races 41, 44, 47, 49, 53, 67, 73, and 108 of *U. appendiculatus* under greenhouse conditions, results indicate that Croissant possesses two genes, *Ur-3* and *Ur-6* for resistance to the bean rust pathogen (Table 3). The *Ur-3* gene is from the Middle American gene pool, and *Ur-6* is from the Andean gene pool. Because the rust pathogen may be variable from year to year and location to location, bean cultivars with two or more rust resistance genes, especially those representing both Andean and Middle American gene pools, have a broader spectrum of resistance in time and space and tend to be more durable.

Cooking and canning evaluations were conducted on seed grown the 2009 CDBN (Table 3). Entries were rated on a scale for three attributes: variation in seed size, uniformity of color, and appearance of the cooked, canned product on a scale where 0 is considered very poor, 1 is acceptable, and 2 is premium. Croissant was rated 1.50 for variation in seed size, 1.25 for uniformity of color, and 0.88 for appearance of the cooked product. Croissant was similar to or better than the five test cultivars in uniformity of size, uniformity of color, and appearance, with the exception that Lariat had a superior appearance of the canned product. These results indicate that Croissant has acceptable seed and canning qualities for the commercial processor.

Availability

Foundation seed of Croissant was released to seed producers in May 2008 and is currently available from the Western Colorado Research Center, 3168 B 1/2 Road, Grand Junction, CO 81503–9621 (Ph: 970-434-3264; Fax: 970-434-1035). Plant Variety Protection under Title V has been granted (PVP No. 200900274) for Croissant. A technology fee payable to Colorado State University and collected by the certification agency in the state of production will be assessed on all registered and certified seed produced. Contact the Colorado Seed Growers Association (970-491-6202) for details about the technology fee. Seed for testing is available from Mark Brick, Department of Soil and Crop Sciences, Colorado State University, Fort Collins, CO 80523, 970-491-6551 or Mark.Brick@Colostate.edu. Seed of Croissant has been deposited in the USDA-ARS National Plant Germplasm System and will be available for distribution upon expiration of Plant Variety Protection.

Acknowledgments

The development of this cultivar was supported by the Colorado Agricultural Experiment Station, the Colorado Dry Bean Administrative Committee, and the Colorado Seed Growers Association. We want to especially thank Mr. Eric Sandsted (Cornell University) for providing canning data, the participants in the Midwest Regional Performance Nursery (Drs. J. Kelly, J. Osorno, and C. Urrea), the participants in the Western Regional Bean Trials (Dr. C. Urrea), and all the participants in the Cooperative Dry Bean Nursery.

References

Adams, M.W. 1982. Plant architecture and yield breeding in *Phaseolus vulgaris* L. Iowa State J. Res. 56:225–254.

Brick, M.A., and K. Grafton. 1999. Improvement of medium seeded race Durango cultivars. p. 223–253. *In* S.P. Singh (ed.) Common bean improvement in the twenty-first century. Kluwer Academic Publishers, Boston, MA.

Burke, D.W. 1982a. Registration of pinto beans NW-410 and NW-590. Crop Sci. 22:684–685.

Burke, D.W. 1982b. Registration of pink beans Viva, Roza and Gloria. Crop Sci. 22:684.

Burke, D.W., M.J. Silbernagel, J.M. Kraft, and H.H. Koehler. 1995. Registration of 'Othello' pinto bean. Crop Sci. 35:943.

Cook, E.R., C.A. Woodhouse, C.A. Eakin, D.M. Meko, and D.W. Stahle. 2004. Long-term aridity changes in the Western United States. Science 306:1015–1018.

Kelly, J.M., and M.W. Adams. 1987. Phenotypic recurrent selection in ideotype breeding in pinto beans. Euphytica 36:69–80.

Kelly, J.M., G.V. Varner, and B. Long. 2010. Registration of 'Santa Fe' pinto bean. 2010. J. Plant Reg. 4:12–16.

Miklas, P.N., D.P. Coyne, K.F. Grafton, N. Mutlu, J. Reiser, D. Lindgren, and S.P. Singh. 2003. A major QTL for common bacterial blight resistance derives from the common bean great northern landrace cultivar Montana No. 5. Euphytica 131:137–146.

Miklas, P.N., J.D. Kelly, S.E. Beebe, and M.W. Blair. 2006. Common bean breeding for resistance against biotic and abiotic stresses: From classical to MAS breeding. Euphytica 147:106–131.

Miller, S.D., D.J. Lyon, and M.A. Brick. 2004. Crop rotation. p. 23–26. *In* H.F. Schwartz, M.A. Brick, R.M. Harveson, and G.D. Franc (ed.) Dry bean production and pest management. Reg. Bull. 562A. Coop. Ext. Res. Center, Colorado State Univ., Fort Collins.

Mutlu, N., P.N. Miklas, J.R. Steadman, A.K. Vidaver, D.T. Lindgren, J. Reiser, D.P. Coyne, and M.A. Pastor-Corrales. 2005. Registration of common bacterial blight resistant pinto bean germplasm line ABCP-8. Crop Sci. 45:806–807.

Osorno, J.M., K.F. Grafton, G.A. Rojas-Cifuentes, R. Gelin, and A.J. Vander Wal. 2010a. Registration of 'Lariat' and 'Stampede' pinto beans. J. Plant Reg. 4:5–11.

Osorno, J.M., K.F. Grafton, G.A. Rojas-Cifuentes, R. Gelin, and A.J. Vander Wal. 2010b. Registration of 'ND-307' pinto bean. J. Plant Reg. 4:109–114.

Pastor-Corrales, M.A., and J.R. Stavely. 2002. Using specific races of the common bean rust pathogen to detect rust resistance genes in *Phaseolus vulgaris*. Annu. Rep. Bean Improv. Coop. 45:78–79.

Singh, S.P. 1982. A key for identification of different growth habits of *Phaseolus vulgaris* L. Annu. Rep. Bean Improv. Coop. 25:92–95.

Singh, S.P. 2001. Broadening the genetic base of common bean cultivars: A review. Crop Sci. 41:1659–1675.

Singh, S.P., P. Gepts, and D.G. Debouck. 1991. Races of common bean (*Phaseolus vulgaris*, Fabaceae). Econ. Bot. 45:379–396.

Smith, J. 2004. Harvest. p. 59–69. *In* H.F. Schwartz, M.A. Brick, R.M. Harveson, and G.D. Franc (ed.) Dry bean production and pest management. Reg. Bull. 562A. Coop. Ext. Res. Center, Colorado State Univ., Fort Collins.

Stavely, J.R., J.D. Kelly, K.F. Grafton, J. Steinke, J.R. Steadman, D.P. Coyne, D.T. Lindgen, and M.J. Silbernagel. 1994. Recent rust resistant bean germplasm releases. Annu. Rep. Bean Improv. Coop. 27:247–248.

Stavely, J.R., and M.A. Pastor-Corrales. 1989. Rust. p. 159–194. *In* H.F. Schwartz and M.A. Pastor-Corrales (ed.) Bean production problems

in the tropics. 2nd. ed. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
Stavely, J.R., J. Steinkle, R.T. McMillan, K.F. Grafton, J.R. Steadman, J.D. Kelly, D.P. Coyne, D.T. Lindgren, and M.J. Silbernagel. 1992. Rust resistant bean germplasm releases. Annu. Rep. Bean Improv. Coop. 35:228–229.
USDA National Agricultural Statistics Service (USDA-NASS). 2010. Crops and plants, field crops, dry bean production 1987, 1988, 1989, 2007, 2008, 2009. USDA-NASS, Washington, D.C.