

## Hernán Ceballos

Argentinean, born in 1954, married, with two sons. B.S. in Agronomy (1980, National University of Córdoba, Argentina) and Ph.D. in Plant Breeding (1987, Cornell University, USA). Major in Plant Breeding, minors in Plant Pathology and International Agriculture. Since graduation working mostly for the International Agriculture Research Centers System first in the Maize Program at the International Maize and Wheat Improvement Center (CIMMYT) in Mexico and Colombia, and later for International Center for Tropical Agriculture (CIAT). Experience in **1)** Population improvement and development of inbred lines for good agronomic performance, disease and insect resistance and tolerance to acid soils and drought in tropical and subtropical maize; **2)** Advising national research programs from Africa, SE Asia and Latin America and Caribbean Regions in their breeding activities; **3)** Basic research on the inheritance of different traits; **4)** Management of field activities; **5)** Directing M.S. and Ph.D. student theses; **6)** Teaching graduate courses on *Quantitative Genetics*, *Methods of Plant Breeding* and *Breeding for Biotic and Abiotic Stresses* at National University of Colombia; **7)** Chickpea, maize, and cassava breeding; **8)** Leader of a research project involving the management of about 25 people; **9)** Search for financial resources, writing research proposals and reports and maintaining close and productive contacts with donors/investors; **10)** Innovations in cassava breeding: by searching, identifying and exploiting high-value traits (particularly nutritional and starch quality) and through the efforts to introduce inbreeding.

**Personal goals:** to work in an institution interested in the development and improvement of crops and/or human resources through research and higher education. As every breeder, I enjoy developing improved cultivars that will benefit farming systems, reduce poverty and/or the footprint left by agriculture. My experience managing personnel and fieldwork, determining research priorities and interacting with personnel from different maize/cassava breeding programs in South America, Asia and Africa has been positive and valuable. Teaching at the University level has been an enjoyable activity. I consider myself a flexible person, adaptable and able to work comfortably within a multidisciplinary team. I would like to work in a location that will offer a positive environment for my family.

### ***PERSONAL INFORMATION***

Born in Argentina in 1954. Married to Zaida J. Lentini Gil (Venezuelan, Ph.D. from Cornell University – Plant Geneticist with specialty in Molecular Breeding) and father of two sons. Fluent on English and Spanish and can communicate in Portuguese.

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### ***EDUCATION***

\* **Ingeniero Agrónomo:** May 1980. Universidad Nacional de Córdoba, Argentina.

*Major:* Agronomy and Crop Production.

\* **Ph.D.:** May 1987. Cornell University, Ithaca, New York, USA

*Major:* Plant Breeding.

*Minors:* Plant Pathology and International Agriculture.

*Dissertation topics:* Genetics of resistance to Southern and Northern Corn Leaf Blights (*B. maydis* race T and *E. turcicum* race 2. Effect of different sources of cytoplasmic male sterility in agronomic traits of maize.

### ***WORKING EXPERIENCE***

**January 1999 - Present:** International Staff as cassava breeder and Leader of Cassava Project at the International Center for Tropical Agriculture (CIAT). Cali, Colombia. Principal activities: **1)** Direct pre-breeding and breeding activities in the field, and coordinate the activities of other cassava scientists (pathology, entomology, agronomy, processing technologies and molecular biologists); **2)** Interact with the private sector (mainly starch, bio-ethanol, snacks, and animal feed industries) for defining research objectives; **3)** Manage the cassava-breeding project at CIAT; **4)** Search for financial resources required for the functioning of the project, including writing research proposals and reports and maintaining close and productive contacts with donors/investors; **5)** Develop/adapt new methods for the genetic improvement of cassava particularly for the introduction of inbreeding, including the development of protocols for the production of doubled-haploids; **6)** Screening and identification of genetic variation for high-value cassava germplasm with positive results: high pro-vitamin A; amylose-free starch; small-granule and high amylose mutations; and tolerance to post-harvest physiological deterioration; **7)** Reviewer in different journals (Acta Agronómica, Canadian Journal of Plant Sciences, Crop Science, Euphytica, European Journal of Plant Pathology, Journal of Agriculture and Food Chemistry, Journal of Plant Breeding and Crop Science, Molecular Breeding, Plant Breeding, Plant Molecular Biology, Plant Molecular Biology Reporter, Starch/Stärke)

**December 1994 – July 2007:** Associate Professor, Universidad Nacional de Colombia (Palmira Campus) and Plant Breeding Graduate School Coordinator. Director of M.S. and Ph.D. theses, lecturer of three graduate courses: **1)** *Quantitative Genetics*; **2)** *Breeding for Biotic and Abiotic Stresses* and **3)** *Methods of Plant Breeding*.

**November 1989 - March 1994:** International Staff as maize breeder, Maize Program - International Maize and Wheat Improvement Center (CIMMYT) at the South American Regional Office. Cali, Colombia. Principal activities: **1)** Development of germplasm (populations and inbred

lines) tolerant to acid soils, aluminum toxicity and phosphorus deficiency. Planning, conducting and analyzing results of evaluation trials carried out in Colombia and other South American countries. Preparing experimental plots to attain the desired type/level of edaphic stress; **2)** Advice to South American National Programs in the areas of crop breeding, availability and suitability of different germplasm, management of different diseases and seed production of highland maize; **3)** Development of experimental lines for basic research on the genetics (including molecular markers) and physiology of tolerance to acid soils; **4)** Organizing international scientific events of regional relevance; **5)** Advising M.S. students in their theses.

**June 1987 - November 1989:** Post-doctoral fellow and later Associate Scientist. Maize Program, CIMMYT, Mexico. Principal activities: **1)** Development and improvement of tropical and subtropical maize germplasm for improved agronomic performance, disease resistance (northern and southern corn leaf blights, Tar Spot Complex, stalk and ear rots, etc) and insects (Fall armyworm and different species of corn borers); **2)** Training of scientists from national research programs; **3)** Research on the inheritance of disease resistance, gains of selection, and heterotic patterns in tropical maize populations; **4)** Participated in the pioneering work on tolerance to drought in maize.

**August 1983 - June 1987:** Graduate Research Assistant. Plant Breeding Department, Cornell University. Ithaca, USA **1)** Genetics of resistance to Southern and Northern Corn Leaf Blights. **2)** Effects of different sources of cytoplasmic male-sterility on different agronomic traits in maize. Epidemiological effect of '*multiplasms*' in the development of Southern Corn Leaf Blight (*B. maydis* race T). **3)** Development of inbred lines for potential use in commercial hybrids.

**August 1980 - August 1983:** Plant Breeding Instructor, Agriculture College, National University of Córdoba, Argentina. Chickpea breeder for the North Western producing area of Córdoba Province.

**August 1978- March 1980:** Teaching assistant, Plant Breeding. Agriculture College, National University of Córdoba, Argentina.

#### **AWARDS**

**National Award on the Technological Innovation category.** Awarded by the Colombian Association for the Advancement of Science (2008).

**Outstanding international scientist award.** Awarded by CIAT Board of Trustees on its 54<sup>th</sup> Annual Meeting (2006).

#### **PEER REVIEWED SCIENTIFIC PUBLICATIONS**

1. Peiretti, D.A., H. Ceballos, R.E. Macchiavelli and M. Fernandez (1986). Efectos de la inducción de andro-esterilidad por aplicación de AG3 sobre la producción de semilla F1 en girasol (*Helianthus annuus* L.). **Revista de Ciencias Agropecuarias** V:25-33.
2. Ceballos, H. and V.E. Gracen (1988). A new source of resistance to *Bipolaris maydis* race T in corn. **Maydica** 33:233-246.
3. Ceballos, H. and V.E. Gracen (1989). A dominant inhibitor gene inhibits the expression of *Ht2* in corn inbred lines related to B14. **Plant Breeding** (Zeitschrift fur Pflanzenzuchtung) 102:35-44.
4. Ceballos, H. and V.E. Gracen (1990). Effect of nuclear resistance and multiplasms on yield losses to *Bipolaris maydis* race T. **Maydica** 35:241-246.

5. Ceballos, H., J.A. Deutsch and H. Gutiérrez (1991). Recurrent selection for resistance to *Exserohilum turcicum* in eight subtropical maize populations. **Crop Science** 31:964-971.
6. Ceballos, H. and J.A. Deutsch (1992). Inheritance of resistance to Tar Spot Complex in maize. **Phytopathology** 82:505-512.
7. Borrero, J.C., S. Pandey and H. Ceballos (1992). Performance and stability of tropical maize hybrids developed from lines with different levels of inbreeding. **Maydica** 37:251-258.
8. Granados, G., S. Pandey and H. Ceballos (1993). Response to selection for tolerance to acid soils in a tropical maize population. **Crop Science** 33:936-940.
9. Ceballos, H., S. Pandey, E.B. Knapp and J. Duque-Vargas (1994). Tolerancia a suelos ácidos en poblaciones tropicales de maíz del CIMMYT. **Agronomía Mesoamericana** 5:96-103.
10. Duque-Vargas, J., S. Pandey, G. Granados, H. Ceballos and E.B. Knapp (1994). Inheritance of tolerance to soil acidity in tropical maize. **Crop Science** 34:50-54.
11. Pandey, S., H. Ceballos, R. Magnavaca, A.F.C. Bahía and L.E. Vinasco (1994). Genetics of tolerance to soil acidity in tropical maize. **Crop Science** 34: 1511-1514.
12. Pérez-Velásquez, J.C., H. Ceballos, S. Pandey and C. Díaz-Amaris (1995). Analysis of diallel crosses among Colombian landraces and improved populations of maize. **Crop Science** 35:572-578.
13. Pandey, S., H. Ceballos and G. Granados (1995). Registration of four tropical maize populations with acid-soil tolerance. **Crop Science** 35:1230-1231.
14. G. Granados, S. Pandey and H. Ceballos (1995). Registration of acid soil tolerant maize populations SA-3 and SA-8. **Crop Science** 35:1236.
15. Borrero, J., S. Pandey and H. Ceballos (1995). Genetic variances for tolerance to soil acidity in a tropical maize population. **Maydica** 40:283-288.
16. León, L.A., S. Pandey and H. Ceballos (1995). Niveles críticos de saturación de aluminio y fósforo aprovechable para variedades tolerantes a suelos ácidos. **Suelos Ecuatoriales** 25:40-43.
17. Urrea-Gómez, R., H. Ceballos, S. Pandey, A.F.C. Bahía Filho and L.A. León (1996). Greenhouse screening technique for acid soil tolerance in maize (*Zea mays* L.). **Agronomy Journal** 88:806-812.
18. Ceballos, H., J.A. Arroyave and J.C. Valor (1996). Potencial de *Mycodiplosis fungicola* en el control biológico de royas en maíz. **Boletín de la Asociación Colombiana de Fitopatología**. Vol 22(3):42-43.
19. Salazar, F., S. Pandey, L. Narro, J.C. Pérez-V., H. Ceballos, S. Parentoni, A. Bahia Filho and C. de León (1997). Diallel analysis of acid-soil tolerant and intolerant tropical maize populations. **Crop Science** 37:1457-1462.
20. Ceballos, H., S. Pandey, L. Narro and J.C. Pérez-Velásquez (1998). Additive, dominant and epistatic effects for maize grain yield in acid and non-acid soils. **Theoretical and Applied Genetics** 96:662-668.
21. Chávez, A.L., J.M. Bedoya, T. Sánchez, C. Iglesias, H. Ceballos and W. Roca (2000). Iron, carotene, and ascorbic acid in cassava roots and leaves. **Food and Nutrition Bulletin** 21:410-413.
22. Ceballos, H., A.L. Chávez, T. Sánchez, J.M. Bedoya, J. Echeverri and J. Tohme (2002). Genetic potential to improve carotene content of cassava and strategies for its deployment. **The Journal of Nutrition** 132(9S):2988S.
23. Ceballos, H., C.A. Iglesias, J.C. Pérez and A.G.O. Dixon (2004). Cassava breeding: opportunities and challenges. **Plant Molecular Biology** 56:503-515.
24. Jaramillo, G., N. Morante, J.C. Pérez, F. Calle, H. Ceballos, B. Arias and A.C. Bellotti (2005). Diallel analysis in cassava adapted to the midaltitude valleys environment. **Crop Science** 45:1058-1063.
25. Pérez J.C., H. Ceballos, G. Jaramillo, N. Morante, F. Calle, B. Arias and A.C. Bellotti (2005). Epistasis in cassava adapted to mid-altitude valley environments. **Crop Science** 45:1491-1496.
26. Chávez, A.L., T. Sánchez, G. Jaramillo, J.M. Bedoya, J. Echeverry, E.A. Bolaños, H. Ceballos and C. A. Iglesias (2005). Variation of quality traits in cassava roots evaluated in landraces and improved clones. **Euphytica** 143:125-133.
27. Calle, F., J.C. Pérez, W. Gaitán, N. Morante, H. Ceballos, G. Llano and E. Álvarez (2005). Diallel inheritance of relevant traits in cassava (*Manihot esculenta* Crantz) adapted to acid-soil savannas. **Euphytica** 144(1-2):177-186.
28. Pérez, J.C., H. Ceballos, F. Calle, N. Morante, W. Gaitán, G. Llano and E. Álvarez, (2005). Within-family genetic variation and epistasis in cassava (*Manihot esculenta* Crantz) adapted to the acid-soils environment. **Euphytica** 145 (1-2):77-85

29. Cach, N.T., J.C. Pérez, J.I. Lenis, F. Calle, N. Morante and H. Ceballos (2005). Epistasis in the expression of relevant traits in cassava (*Manihot esculenta* Crantz) for subhumid conditions. **Journal of Heredity** 96(5):586-592.
30. Sánchez, T., A.L. Chávez, H. Ceballos, D.B. Rodríguez-Amaya, P. Nestel and M. Ishitani (2006). Reduction or delay of post-harvest physiological deterioration in cassava roots with higher carotenoid content. **Journal of the Science of Food and Agriculture** 86(4): 634-639.
31. Pérez Velásquez, J.C., H. Ceballos, E. Ortega and J.I. Lenis (2005). Análisis de la interacción genotipo por ambiente en yuca (*Manihot esculenta* Crantz) usando el modelo AMMI. **Fitotecnia Colombiana** 5(2):11-19.
32. Morante, N., X. Moreno, J.C. Pérez, F. Calle, J.I. Lenis, E. Ortega, G. Jaramillo and H. Ceballos (2005). Precision of selection in early stages of cassava genetic improvement **Journal of Root Crops** 31:81-92.
33. Lenis, J.I., F. Calle, G. Jaramillo, J.C. Pérez, H. Ceballos and J. Cock (2006). Leaf retention and cassava productivity. **Field Crops Research** 95(2-3):126-134.
34. Tofiño, A., M. Fregene, H. Ceballos and D. Cabal (2006). Regulación de la biosíntesis del almidón en plantas terrestres: perspectivas de modificación. **Acta Agronómica** 55(1):1-13.
35. Ceballos H., T. Sánchez, A.L. Chávez, C. Iglesias, D. Debouck, G. Mafla and J. Tohme (2006). Variation in crude protein content in cassava (*Manihot esculenta* Crantz) roots. **Journal of Food Composition and Analysis** 19:589-593
36. Cach T.N., J.I. Lenis, J.C. Pérez, N. Morante, F. Calle and H. Ceballos (2006). Inheritance of relevant traits in cassava (*Manihot esculenta* Crantz) for sub-humid conditions. **Plant Breeding** 125(2):177-182.
37. Ceballos, H., M. Fregene, Z. Lentini, T. Sánchez, Y.I. Puentes, J.C. Pérez, A. Rosero and A.P. Tofiño (2006). Development and Identification of High-Value Cassava Clones. **Acta Horticulturae** 703:63-70.
38. Checa, O., H. Ceballos and M.W. Blair (2006). Generation mean analysis of climbing ability in common bean (*Phaseolus vulgaris* L.). **Journal of Heredity** 97(5):456-465.
39. Posada, C.A., A. López-G. and H. Ceballos (2006). Influencia de harinas de yuca y de batata sobre pigmentación, contenido de carotenoides en la yema y desempeño productivo de aves en postura. **Acta Agronómica** 55(3):47-54.
40. Fregene, M., N. Morante, T. Sánchez, J. Marín, C. Ospina, E. Barrera, J. Gutierrez, J. Guerrero, A. Bellotti, L. Santos, A. Alzate, S. Moreno and H. Ceballos (2006). Molecular markers for introgression of useful traits from wild *Manihot* relatives of cassava, markers assisted selection (MAS) of disease and root quality traits. **Journal of Root Crops** 32:1-31.
41. Chávez, A.L., T. Sánchez, H. Ceballos, D.B. Rodríguez-Amaya, P. Nestel, J. Tohme, M. Ishitani (2007). Retention of carotenoids in cassava roots submitted to different processing methods. **Journal of the Science of Food and Agriculture** 87(3):388-393.
42. Rosero, A., H. Ceballos, M. Fregene, A. Tofiño, N. Morante, J.C. Pérez and W. Castelblanco (2007). Avances en la obtención de variedades de yuca (*Manihot esculenta* Crantz) con alta calidad de almidón mediante mutación inducida. **Fitotecnia Colombiana** 7(1): 13-23.
43. Ceballos, H., T. Sánchez, N. Morante, M. Fregene, D. Dufour, A.M. Smith, K. Denyer, J.C. Pérez, F. Calle and C. Mestres (2007). Discovery of an Amylose-free Starch mutant in cassava (*Manihot esculenta* Crantz). **Journal of Agricultural and Food Chemistry** 55(18):7469-7476.
44. Tofiño, A., H. Romero and H. Ceballos (2007). Efecto del estrés abiótico sobre la síntesis y degradación de almidón. **Agronomía Colombiana** 25(2):254-254.
45. Ceballos, H., T. Sánchez, K. Denyer, A.P. Tofiño, E.A. Rosero, D. Dufour, A. Smith, N. Morante, J.C. Pérez and B. Fahy (2008). Induction and identification of a small-granule, high-amylose mutant in cassava (*Manihot esculenta* Crantz). **Journal of Agricultural and Food Chemistry** 56(16):7215-7222.
46. Tofiño, A., H. Ceballos and H.M. Romero (2008). Posibilidades de expansión del cultivo de yuca (*Manihot esculenta* Crantz) en el Caribe seco colombiano a partir de investigación multidisciplinaria. **Actualidades Biol.** 30(88):15-27.
47. Wissner R.J., S.C. Murray, J.M. Kolkman, H. Ceballos and R.J. Nelson (2008). Selection mapping of loci for quantitative disease resistance in a diverse maize population. **Genetics** 180:583-599.
48. Chávez, A.L., H. Ceballos, D.B. Rodríguez-Amaya, J.C. Pérez, T. Sánchez, F. Calle and N. Morante (2008). Sampling variation for carotenoids and dry matter contents in cassava roots. **Journal of Root Crops** 34(1):43-49.

49. Reddy, B.V.S., S. Ramesh, A. Ashok Kumar, S.P. Wani, R. Ortiz, H. Ceballos and T.K. Sreedevi (2008). Bio-fuel Crops Research for Energy Security and Rural Development in Developing Countries. **BioEnergy Research** 1:248-258.
50. Tofiño, A.P., D. Cabal, H. Romero and H. Ceballos (2008). Caracterización morfológica de una población M1 de yuca (*Manihot esculenta* Crantz) derivada de semillas irradiadas. **Fitotecnia Colombiana** 8(1):39-55.
51. Sánchez, T., G. Mafla, N. Morante, H. Ceballos, D. Dufour, F. Calle, X. Moreno, J.C. Pérez and D. Debouck (2009). Screening of starch quality traits in cassava (*Manihot esculenta* Crantz). **Starch/Stärke** 61:12-19.
52. Tofiño, A., D. Cabal, H. Ceballos, J.C. Pérez and H.M. Romero (2009). Potencial de la técnica TILLING para evaluar progenies endocriadas de germoplasma irradiado de yuca (*Manihot esculenta* Crantz). **Fitotecnia Colombiana** 8:22-32.
53. Contreras Rojas, M., J.C. Pérez, H. Ceballos, D. Baena, N. Morante and F. Calle (2009). Introduction of inbreeding and analysis of inbreeding depression in eight S<sub>1</sub> cassava families. **Crop Science** 49:543-548.
54. Tofiño, A., D. Cabal, H. Ceballos, T. Sánchez, J.C. Pérez and B. Till (2009). Selección fenotípica de progenies endocriadas de germoplasma irradiado de yuca (*Manihot esculenta* Crantz) para análisis Tilling. **Multiciencias** 9:233-241.
55. Tofiño, A., D. Cabal, H. Ceballos, T. Sánchez, J.C. Pérez and H.M. Romero (2009). Validación de TILLING en evaluación de progenies endocriadas de yuca irradiada (*Manihot esculenta* Crantz). **Agronomía Colombiana** 27(3):313-321.
56. Pérez, J.C., H. Ceballos, I.C. Ramirez, J.I. Lenis, F. Calle, N. Morante, G. Jaramillo and M. del C. Lentini (2010). Adjustment for missing plants in cassava evaluation trials. **Euphytica** 172(1): 59-65.
57. Sánchez, T., D. Dufour, I.X. Moreno and H. Ceballos (2010). Pasting and gel stability of waxy and normal starches from cassava, potato, maize, and rice under thermal, chemical and mechanical stress. **Journal of Agricultural and Food Chemistry** 58:5093-5099.
58. Morante, N., T. Sánchez, H. Ceballos, F. Calle, J.C. Pérez, C. Egesi, C.E. Cuambe, A.F. Escobar, D. Ortiz and A.L. Chávez (2010). Tolerance to post-harvest physiological deterioration in cassava roots. **Crop Science** 50:1333-1338.
59. Welsch, R., J. Arango, C. Bär, B. Salazar, S. Al-Babili, J. Beltrán, P. Chavarriaga, H. Ceballos, J. Tohme and P. Beyer (2010). Provitamin A - accumulation in cassava (*Manihot esculenta*) roots driven by a single nucleotide polymorphism in a phytoene synthase gene. **The Plant Cell** 22:3348-3356.
60. Rosero-Alpala, E.A., C. Cuambe, C. Egesi, T. Sánchez, N. Morante, H. Ceballos, M. Fregene and J.G. Morales-Osorio (2010). Introgresión de la resistencia al deterioro fisiológico poscosecha en yuca. **Acta agronómica** 59(2): 180-187.
61. Alzate-G, A.M., F.A. Vallejo-Cabrera, H. Ceballos Lascano, J.C. Pérez and M. Fregene (2010). Variabilidad genética de la yuca cultivada por pequeños agricultores de la región Caribe de Colombia. **Acta Agronómica** 59(4):385-393.
62. Ortiz, D., T. Sánchez, N. Morante, H. Ceballos, H. Pachón, M.C. Duque, A.L. Chávez and A.F. Escobar (2011). Sampling strategies for proper quantification of carotenoids content in cassava breeding. **Journal of Plant Breeding and Crop Science** 3(1):14-23.
63. Zhao, S., H. Ceballos, D. Dufour, T. Sánchez and P. Zhang (2011). Development of waxy cassava with different biological and physico-chemical characteristics of starches for industrial applications. **Biotechnology & Bioengineering** 108(8):1925-1935.
64. Wang, C., Z. Lentini, E. Tabares, M. Quintero, H. Ceballos, B. Dedicova, C. Sautter, C. Olaya and Z. Peng (2011). Microsporogenesis and pollen formation in cassava (*Manihot esculenta* Crantz). **Biologia Plantarum** 55(3):469-478.
65. Njoku, D., V. Gracen, C.N. Egesi, I. Asante, S.K. Offei, E. Okogbenin, P. Kulakow, O.N. Eke-Okoro and H. Ceballos (2011). Breeding for enhanced  $\beta$ -carotene content in cassava: constraints and accomplishments. **Journal of Crop Improvement** 25:560-571.
66. Pérez, J.C., J.I. Lenis, F. Calle, N. Morante, T. Sánchez, D. Debouck and H. Ceballos (2011). Heritability of root peel thickness and its influence in extractable starch from cassava (*Manihot esculenta* Crantz) roots. **Plant Breeding** 130:688-693.

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69. Guimaraes. E.P., D. Debouck, S. Beebe, C.P. Martínez, C. Hershey and H. Ceballos (2011). Pre-breeding: an alternative to add value to the plant genetic resources. **Journal of the Swedish Seed Association** 118(2):8-15.
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72. Ceballos, H., P. Kulakow, and C. Hershey. 2012. Cassava Breeding: Current Status, Bottlenecks and the Potential of Biotechnology Tools. **Tropical Plant Biology** 5(1):73-87.
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74. Ceballos, H., C. Hershey and L.A. Becerra-López-Lavalle (2012). New approaches to cassava breeding. **Plant Breeding Reviews** 36:427-504.
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