‘Roquerola’ and ‘Montferri’, First Improved Onion (*Allium cepa* L.) Cultivars for “Calçots” Production

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“Calçots” are the floral stem of second-year onion resprouts of the ‘Blanca Tardana de Lleida’ onion landrace. These resprouts are harvested during winter (December to April) when they reach the commercial size for consumption, i.e., when the edible white part is ≈ 200 mm long and 25 mm in diameter. Each onion yields between one and 20 “calçots,” and their thickness is negatively correlated with the number of “calçots” per onion, i.e., plants with a high number of resprouts yield few, if any, commercial “calçots.” In the field management, all the resprouts from an onion are harvested at the same time, when 50% or more reach the commercial size indicated as specified in the regulations for the ‘Calçot de Valls’ Protected Geographical Indication (<http://www.gencat.cat>). This particular use of the onion is typical of Catalonia (northeast Spain), where “calçots” are usually grilled or roasted. The tradition dates from the 1930s and has recently started to spread to other regions in Spain and other countries; the current market volume is ≈ 20 million Euros and is quickly rising. Traditionally producers have used local populations of the landrace and no breeding programs had been undertaken (Muñoz et al., 2003), resulting in large differences in the yield of commercial “calçots” per plant and low total yields.

Compared with previously existing populations, the two new cultivars obtained, ‘Roquerola’, an early cultivar, and ‘Montferri’, a late cultivar, significantly increase the mean number of commercial “calçots” obtained from each plant while maintaining the sensory characteristics. The combined use of these two cultivars makes it possible to begin the growing season earlier and maintain production throughout the winter, when the demand is highest.

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Origin

After exhaustively collecting ‘Blanca Tardana de Lleida’ onion landrace from farmers in the traditional area of cultivation, we obtained 16 different accessions and characterized them according to their agronomic, morphological, and sensory traits. Together with surveys of farmers and consumers, this analysis enabled us to define an idiootype that combines the relevant sensory characteristics (high sweetness, low fiber perception, and lack of off-flavors) with good agronomic performance (≈ 10 commercial “calçots” per plant, homogeneity of “calçot” size within and between plants, and low variability for earliness).

Although several accessions reached the standards for sensory attributes, none had high scores for the agronomic traits (e.g., optimum number of commercial “calçots” per plant or low earliness dispersion). We, therefore, designed a breeding program to obtain more productive early and late cultivars.

In the Fall of 2004, we replanted 10,000 onions (1,000 onions from each of the most promising 10 accessions) in a single field. Individual plants were controlled to determine the number of commercial “calçots” per plant and the time to harvesting (when 50% or more reach commercial size). In Mar. 2005, we used this information to select 50 early plants and 50 late plants that were similar to the idiootype. In the same month (Mar. 2005), the “calçots” from these plants were separated and transplanted into isolated multiplication fields; thus, each plant was represented by 10 floral stems (500 floral stems in the field with the early material and 500 in the field with the late material). The two groups were allowed to pollinate freely and the seeds from the floral stems of each mother plant were grouped. In the Fall of 2005, the seeds from each mother plant (mixture of half-sib and selfed seed) were sown, and in June 2006, the onions bulbs were harvested. In the Fall of 2006, they were replanted to study the production of “calçots” in the offspring of the selected mother plants. Every week until Mar. 2007, we recorded the number of commercial-sized “calçots”

and the earliness of 50 offspring of each mother plant selected in the first year (2500 early plants and 2500 late plants). On the basis of the mean values for the offspring and the individual values within each family, we chose eight plants from the field with the early material and eight plants from the field with the late material from which to create the two new varieties. Like in the first year, 10 “calçots” were separated from the selected plants and planted in the same month (Mar. 2007) in two isolated multiplication fields. The seeds obtained through open pollination were bulked to constitute the base of the new cultivars (June 2007). After multiplication by open pollination again, these materials were cultivated in three locations, La Masó (lat. 41°13'47" N, long. 01°13'12" E), Valls (lat. 41°16'32" N, long. 01°14'19" E), and Altafulla (lat. 41°08'50" N, long. 01°22'56" E), from Oct. 2009 to Mar. 2010 to confirm stability and homogeneity.

Description

The “calçot” plants of the ‘Roquerola’ variety (Fig. 1A) are early, producing four to six commercial-sized “calçots” in January and from five to seven if allowed to grow until March. The edible part of the “calçots” is of intermediate length (145 mm to 175 mm) and width (19 mm to 22.5 mm). The leaves are dark green, intermediately erect, and resistant to cracking; the position of the exterior leaves is high (mean, 574 mm). The edible part is white. This cultivar is a long-day, non-storage type and its flat globe-shaped bulb weighs 149 to 172 g with white skin and flesh. This onion has low storage capacity. The flower is white and the mean 100-seed weight is 0.251 g. The incidence of the onion yellow dwarf virus is very low both during the growth of the onions and during the growth of the “calçots.”

The “calçot” plants of the ‘Montferri’ variety (Fig. 1B) are late, producing only two

Fig. 1. Aspect of a simple plant of ‘Roquerola’ variety with 11 commercial “calçots” (A) and 13 commercial “calçots” coming from a simple plant of ‘Montferri’ variety, ready for packaging (B).

to four commercial-sized “calçots” in January and from six to nine if allowed to grow until March. The edible part of the “calçots” is of intermediate length (175 mm to 215 mm) and width (20.5 mm to 25 mm). The leaves are dark green, intermediately erect, and resistant to cracking; the position of the exterior leaves is high (mean, 626 mm). This cultivar is a long-day, non-storage type and its flat globe-shaped bulb weighs 168 to 203 g with white skin and flesh. The flower is white and the mean 100-seed weight is 0.258 g. The incidence of the onion yellow dwarf virus is very low both during the growth of the onions and during the growth of the “calçots.”

In the 2009–2010 and 2010–2011 growing seasons, we cultivated the two new varieties, the base population, and two well-known Spanish landraces of onion, ‘Babosa’ and ‘Nerja’, from the Genebank of the Institute of Conservation and Improvement of the Agrobiodiversity of the Polytechnic University

of Valencia were cultivated at La Masó (lat. 41°13′47″ N, long. 01°13′12″ E) at a farm representative of the ‘Calçot de Valls’ Geographic Protected Designation.

Onions from the two new cultivars were slightly larger than those of the base population with a size intermediate between the checks ‘Babosa’ and ‘Nerja’ (Table 1). The plants derived from the onions of the two new cultivars produced a significantly higher number of “calçots” and of commercial-sized “calçots” (Table 1). Compared with the base population, in January, the early cultivar, Roquerola, had 320% more commercial-sized “calçots” and the late cultivar, Montferri, had 165% more. In February, the early cultivar had 76% more “calçots” than the base population and the late cultivar had 116% (Table 1). The control ‘Nerja’ did not differ significantly from the base population and the control ‘Babosa’ produced fewer “calçots” (Table 1).

The morphological traits of the “calçots” of the two new cultivars were very similar to those of the landrace, although the edible portion of the “calçots” in the late cultivar was significantly longer than in the base population and in the early cultivar (Table 2). The length of the edible portion of the “calçot” in the control ‘Nerja’ was similar to that of the late cultivar, Montferri, although the diameter of the “calçots” from the control was significantly smaller than in “calçots” from the base population and those from the two improved cultivars (Table 2). The control ‘Babosa’ had lower values for all the morphological traits (Table 2).

The sensory analysis found no significant changes in the three key traits studied between “calçots” from the base population and those from the two new cultivars (Table 2). In contrast, none of the checks had the same sensory quality as the three Blanca Tardana de Lleida materials studied if we consider all three traits in the idiotype (Table 2). As expected for the selected trait (number of commercial “calçots”), the variation coefficient decreased from the landrace to Roquerola and Montferri (from 1.8 to 0.88 and 0.80 in the first harvest and from 0.78 to 0.63 and 0.66 in the second harvest, respectively). This is very favorable for the management and commercialization of the product.

Because the significant increase in the yield of “calçots” was achieved without lowering sensory quality, farmers are already trying out the two new cultivars while the cultivars are being registered. Small samples of ‘Roquerola’ and ‘Montferri’ seeds are available for research purposes (contact the author).

Table 1. Morphological and agronomic traits of onions and the derived “calçot” plants for the ‘Blanca Tardana de Lleida’ landrace (the mixed population used as the starting point for breeding), new cultivars Roquerola and Montferri, and ‘Babosa’ and ‘Nerja’ used as checks.

	Onion			Plant (calçots)		
	Width (mm)	Length (mm)	Wt (g)	January ^x	March ^w	Total ^y
Landrace	67.5 bc ^z	60.1 b	143.9 b	1.1 b	3.7 c	8.7 b
Roquerola	72.8 ab	61.6 ab	165.8 b	4.6 a	6.4 b	12.1 a
Montferri	76.6 a	66.3 a	184.6 ab	2.9 ab	7.9 a	12.9 a
Nerja	60.4 c	44.1 c	83.1 c	1.0 b	3.0 c	7.5 b
Babosa	81.0 a	66.5 a	222.5 a	0.6 b	1.4 d	4.5 c

^zA completely randomized block design was used with three blocks and 50 plants per plot. Means for the same trait followed by the same letter were not significant at $P \leq 0.05$ in Duncan’s multiple range test.

^yNumber of “calçots.”

^xNumber of commercial-sized “calçots” in January.

^wNumber of commercial-sized “calçots” in March.

Table 2. Morphological and sensory traits of “calçots” from the ‘Blanca Tardana de Lleida’ landrace (the mixed population used as the starting point for breeding), new cultivars Roquerola and Montferri, and ‘Babosa’ and ‘Nerja’ checks.^z

	Morphologic traits			Sensory traits		
	Width (mm)	Length (mm)	Wt (g)	Sweetness	Fiber	Off-flavors
Landrace	23.6 a	15.6 c	75.6 a	6.2 ab	2.4 bc	2.8 a
Roquerola	21.1 b	15.9 c	69.5 a	7.1 a	2.5 b	2.5 a
Montferri	23.1 ab	19.0 a	74.2 a	6.2 ab	2.5 b	2.4 a
Nerja	15.6 c	17.9 b	72.0 a	5.2 c	2.2 c	2.8 a
Babosa	16.3 c	14.4 d	75.4 a	5.7bc	3.5 a	3.7 b

^zThe analysis of variance included the fixed factors panelist and accession, the random factor session, and the interaction panelist*accession. Means for the same trait followed by the same letter were not significant at $P \leq 0.05$ in Duncan’s multiple range test. Sensory evaluations were done by a trained panel (eight judges) in a room specifically designed for this purpose (ISO 8589, 2007). Accessions were scored on a semistructured scale from 0 (low) to 10 (high) for all traits (Romero del Castillo et al., 2008). The experimental design had four sessions and four accessions per session, and each accession was tested in triplicate.

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