A germplasm collection of confectionery sunflower landraces from Spain

Leonardo Velasco, José M. Fernández-Martínez, Begoña Pérez-Vich

Instituto de Agricultura Sostenible (IAS-CSIC), Alameda del Obispo s/n, 14004 Córdoba, Spain

lvelasco@ias.csic.es

Introduction

Sunflower was introduced in Europe by Spanish explorers in the 16th century. There are two versions about the year of introduction and the place were sunflower was collected. According to Putt (1977), Spanish explorers introduced sunflower to Spain for the first time in 1510 from New Mexico. However, Lehner and Lehner (1960) stated that Spanish explorers found the sunflower plant in Peru in 1532, where it was worshipped as a sacred image of the sun god, from where it was taken to Spain. After its introduction in Spain, sunflower has been traditionally grown in this country as an ornamental plant in gardens and for the use of seeds as a snack. It has been used also as a border plant in small vegetable gardens (Pardo-Pascual, 1942). This has resulted in the development of an impressive genetic diversity in the form of local landraces. However, such genetic diversity has been lost to a large extent. The introduction of improved cultivars in the second half of the 20th century, together with a gradual replacement of sunflower by maize as a border plant in small vegetable gardens, led to a gradual genetic erosion of confectionery sunflower germplasm in Spain. In the middle 1980's, we started the collection of local landraces of confectionery sunflower in Andalusia region. Collection efforts were interrupted until the 2000's, when new collection expeditions were conducted mainly in three regions: Andalusia, Castilla La Mancha, and Extremadura. Some landraces have been also collected by the Centre of Plant Genetic Resources (CRF) of the National Institute for Agricultural and Food Research and Technology (INIA). The germplasm collection consists of 195 accessions, which are maintained at CRF (http://wwwx.inia.es/inventarionacional/Introduccioneng.asp). This research was aimed at characterizing the collection for morphological, phenological, and biochemical traits.

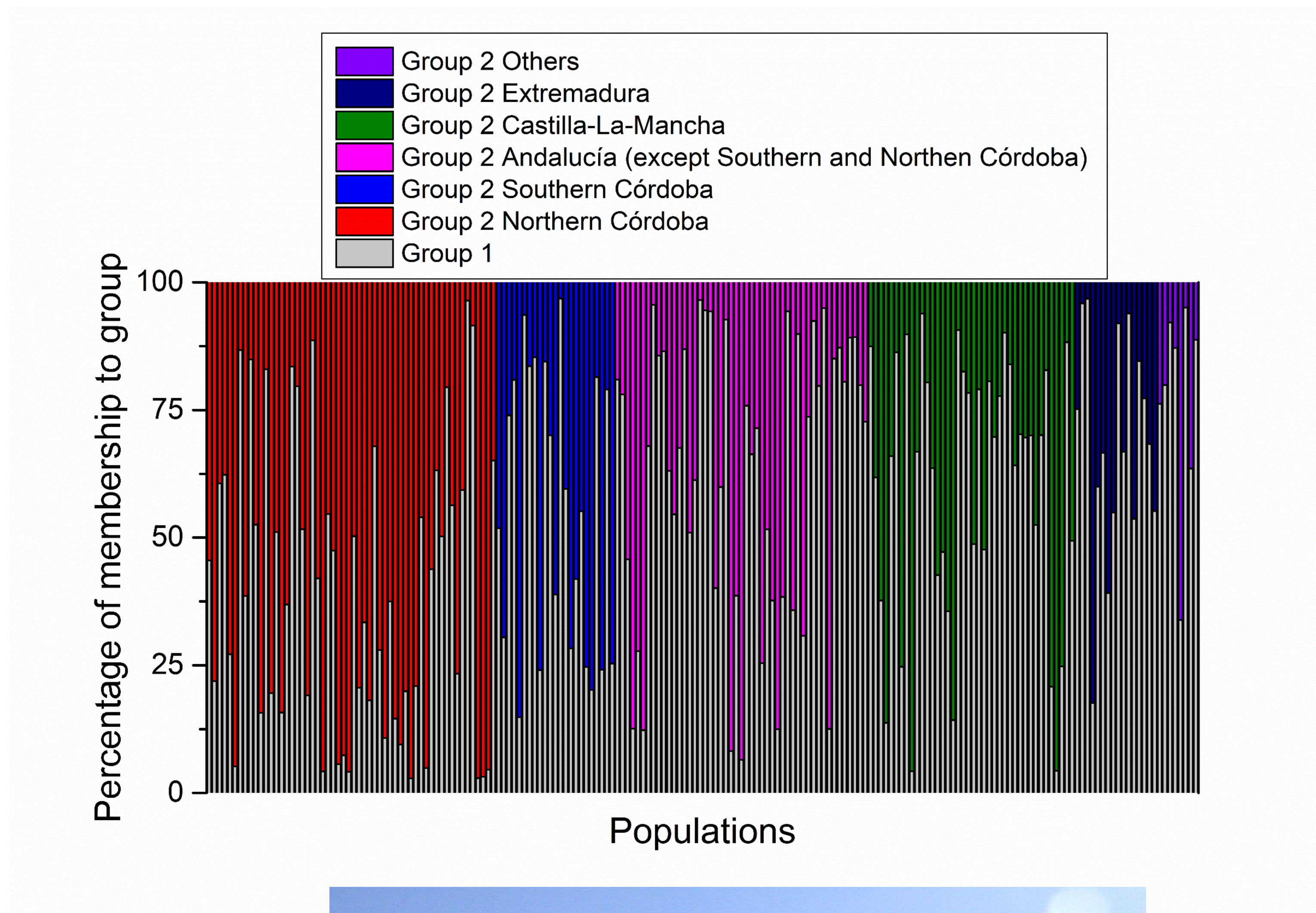
Material and Methods

The methodology of this research has been published in Velasco et al. (2014) and Pérez-Vich et al. (2018)

Results and Discussion

Evaluation of the collection, conducted in Córdoba (Spain) in 2011, 2012, and 2013 (Table 1), revealed large variation for morphological, phenological, and biochemical traits. Great variability was particularly observed for hundred-seed weight (4.2 to 19.7 g), plant height (65.0 to 361.7 cm), head diameter (9.0 to 31.0 cm), seed length (0,9 to 1,8 cm), days to flowering (64.3 to 163.0), oil content (16.0 to 29.8%), fatty acid profile (e.g. oleic acid from 22.9 to 63.9%), kernel tocopherol content (114.0 to 423.2 mg kg-1), kernel squalene content (12.0 to 128.1 mg kg-1), kernel phytosterol content (1344.0 to 2942.5 mg kg-1), and phytosterol profile (e.g. β-sitosterol from 32.3 to 66.1%; Δ^7-stigmastenol from 7.1 to 35.2%). The analysis of the genetic structure of the germplasm collection with a set of 52 SSR markers revealed the existence of two genetic groups, one of them widely distributed geographically and another one linked to a reduced area in the north of Córdoba Province (Fig 1). Genetic diversity of this germplasm collection can be of great utility for widening the genetic base of cultivated sunflower in breeding programs.

Trait	Mean	SD	Minimum	Maximum
Seed length (cm)	1.4	0.2	0.9	1.8
Seed width (cm)	0.8	0.1	0.5	1.2
Seed length/width	1.8	0.2	1.3	2.4
Hundred seed weight (g)	10.3	2.6	4.2	19.7
Kernel (%)	54.4	5.5	39.3	68.1
Plant height (cm)	173.1	57.8	65.0	361.7
Head diameter (cm)	14.9	2.8	9.0	31.0
Days to flowering	92.7	19.9	64.3	163.0
Seed oil content (%)	22.2	2.3	16.0	29.8
Palmitic acid (% total fatty acids)	7.3	1.0	5.6	10.4
Stearic acid (% total fatty acids)	3.7	0.9	1.6	5.8
Oleic acid (% total fatty acids)	38.8	7.6	22.9	63.9
Linoleic acid (% total fatty acids)	50.2	7.3	24.8	66.7
Tocopherol content (mg kg-1)	232.7	64.4	114.0	423.2
α-tocopherol (% tocopherols)	98.3	0.8	96.1	99.8
β-tocopherol (% tocopherols)	1.6	0.8	0.2	3.9
Squalene content (mg kg-1)	38.4	20.3	12.0	128.1
Phytosterol content (mg kg-1)	1959.2	331.1	1344.0	2942.5
Campesterol (% phytosterols)	9.2	2.3	4.4	17.1
Stigmasterol (% phytosterols)	7.9	1.4	4.8	14.1
β-sitosterol (% phytosterols)	57.2	4.6	32.3	66.1
Δ5-avenasterol (% phytosterols)	3.0	1.8	0.2	10.7
Δ7-stigmastenol (% phytosterols)	15.9	4.3	7.1	35.2
Δ7-avenasterol (% phytosterols)	3.3	1.0	1.7	7.5



References

Lehner, E., and J. Lehner. 1960. Folklore and symbolism of flowers, plants and trees. Tudor Publishing Company, New York.
Pardo-Pascual, M. 1942. Cultivo del girasol. Agricultura 11:127-128
Pérez-Vich, B., M.R. Aguirre, B. Guta, J.M. Fernández-Martínez, L. Velasco. 2018. Crop Sci. (In press)
Putt, E.D. 1997. Sunflower early history. In: Sunflower production and technology. ASA-CSSA-SSSA, Madison, WI. p. 1-21
Velasco, L., A. Fernández-Cuesta, J.M. Fernández-Martínez. 2014. Crop Pasture Sci. 65:242-249.