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THE STATUS OF PORTULACA OLERACEA L. IN TENERIFE, THE CANARY ISLANDS

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Resumen. La recolección de material perteneciente a *Portulaca oleracea* y especies afines en Tenerife y algunas otras islas del archipiélago reavivó nuestro interés en este complejo poliploide. Con la intención de homogeneizar el tratamiento de los taxones relacionados a *Portulaca oleracea* L., se propone elevar el rango subespecífico de alguno de ellos a rango específico. Se describe por primera vez para la ciencia *Portulaca canariensis*. El estudio de *Portulaca oleracea* y especies afines en Tenerife y otras islas del archipiélago revelan los siguientes hechos: a. Tres niveles de ploidía (diploide, tetraploide y hexaploide) están presentes en las islas, b. Se observaron poblaciones simpátricas de especies diploides, de tetraploides, de tetraploides más hexaploides, de hexaploides y de diploides más tetraploides y hexaploides y c. Las especies tetraploides fueron las más frecuentes, seguidas de las diploides, siendo las hexaploides las menos frecuentes. Los resultados de los recuentos cromosómicos concuerdan con los estudios previos realizados

Summary. Following a comprehensive collection of *Portulaca oleracea*-related species in Tenerife and a few other Canary Island renewed interest this polyploidy complex led to another progress in its investigations. In order to equalize the treatment of the taxa related to *Portulaca oleracea* L., its subspecies are raised to the specific rank. A new species, *P. canariensis* is described. Our study of the *Portulaca oleracea*-related species found in Tenerife and a few other Canary Island reveal the following facts: a. The three ploidy levels (diploids, tetraploids, and hexaploids) are well represented there, b. Sympatric populations of diploid plus diploid, tetraploids plus tetraploids, tetraploids plus hexaploids, hexaploids plus hexaploids, and diploid plus tetraploid plus hexaploid were discovered there and c. The most frequent species found were tetraploid, then the diploid and the least were hexaploids. Chromosome count followed our findings in previous studies.

INTRODUCTION

Portulaca oleracea is well known to be a cosmopolitan species. In earlier studies (DANIN & al., 1978; DANIN & ANDERSON, 1986; DANIN, 1990) we have shown that it is an unevenly distributed polyploid complex. There is a high vegetative resemblance among the various taxa already described. Their seed-coat characters, seed size, and chromosomes number can be used for distinguishing the taxa. When our first study took place, a few colleagues (e.g. Dr. Peter Raven, 1978, and 2003 pers. comm.) stated:" If these taxa are distinct, recognized, and represent different ploidy levels, they should be recognized at the specific level, even if the differences are limited". This is because they are recognizable by their seed-coat morphology and

biologically isolated by their ploidy level barriers. Our findings were disregarded by MATTHEWS & al. (1993) who concluded that "*P. oleracea* exists as a polymorphic species that is not divisible into subspecies based on seed surface as primary morphological trait". MATTHEWS & al. (l.c.) forgot considering the seeds-size and chromosome number characters which are linked to the seed surface morphology in our studies. They did not check the herbarium specimens we quoted and made themselves easy life by concluding without investing time in finding new facts. They claim that our findings are not reliable and that *Portulaca oleracea* is in fact a polymorphic plant with populations that contain several sets of chromosome numbers and mixed seed-surface types. GEREAU (2001), who followed MATTHEWS & al. (1993) and in a similar way to the latter did not waste time on finding new facts, sunk the two subspecies recorded from Nicaragua into strict synonyms of the species, without giving any explanation. In particular, *Portulaca oleracea* L. subsp. *nicaraguensis* Danin & H. G. Baker, a common diploid of the Gulf of Mexico countries, was not recognized by GEREAU (2001), and nor was subsp. *granulato-stellulata* collected in that country. He probably failed to use a high magnification dissecting microscope with diffused light, as recommended by DANIN & al. (1978, p. 178), and therefore could not see the unique seed coat properties of these taxa. Consequently GEREAU (2001) described for the Nicaraguan *Portulaca* seed properties of *Portulaca oleracea* L. subsp. *oleracea* which do not exist, to our best knowledge, in Nicaragua. On the other hand, RICCERI & ARRIGONI (2000) took the advice given to us by Dr. Raven and raised two of our subspecies to the species level. The new names for these taxa are listed below.

The present study reports the taxonomic analysis of samples of *Portulaca oleracea* group from 56 populations in Tenerife, The Canary Islands. A new species of *Portulaca* is described, and the taxa which were not raised to the species level are raised here to equalize the treatment.

MATERIAL AND METHODS

New collection of seeds from Tenerife was made in October 2003. The locations are listed in appendix 1 with their running numbers. Their distribution is shown in Fig. 1. We also analyzed the specimens deposited in the herbarium of the Department of Biologia Vegetal, of the University of La Laguna, Tenerife (TFC). Populations were determined using seeds size and seed-coat morphology. They were compared to the SEM figures in DANIN & al. (1978). All the specimens quoted here were seen (!). Additional SEM images were taken after being coated with carbon-coating. A few of them are presented here.

Chomosome counts were made for root tips from seeds of sample T30 (see appendix) in order to verify the conclusions from the 1978 study with the Canary Islands material. Seeds from all populations recorded in appendix are deposited at HUJ and TFC. Seeds from populations T04, T05, T10, T14, T25, T32, T34, T38, T40,

LZ2 were planted and individuals were raised from most of them in a greenhouse at La Laguna. Seed morphology of F1 was determined and compared to the parent seed type. Additional chromosome counts were done in Dr. B. Gemeinholzer laboratory at the Berlin-Dahlem Botanical Garden.

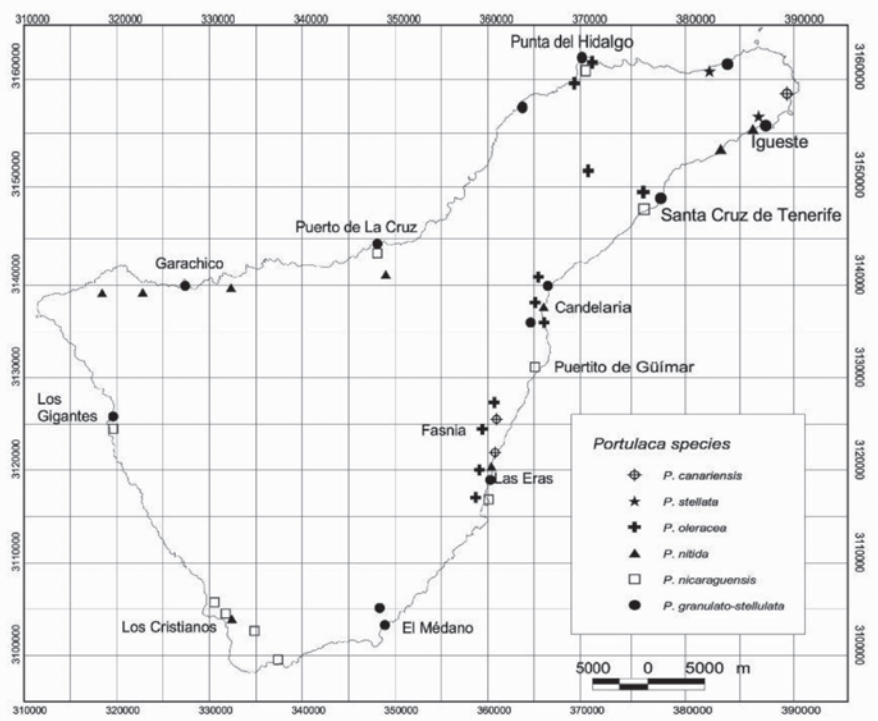

Fig. 1. Locations of the collection sites of *Portulaca* species in Tenerife.

RESULTS

Accepted taxa

Following RICCERI & ARRIGONI (2000) these are the *Portulaca* taxa recognized:

Portulaca oleracea L. (named *Portulaca oleracea* L. subsp. *oleracea* by DANIN & al., 1978). Fig. 2.

Portulaca nicaraguensis (Danin & H. G. Baker) Danin, **stat. nov.**

Basionym and synonym: *Portulaca oleracea* L. subsp. *nicaraguensis* Danin & H. G. Baker in: A. DANIN, I. BAKER, & H. G. BAKER, *Israel J. Bot.* 27: 186-187. 1978. Fig. 3.

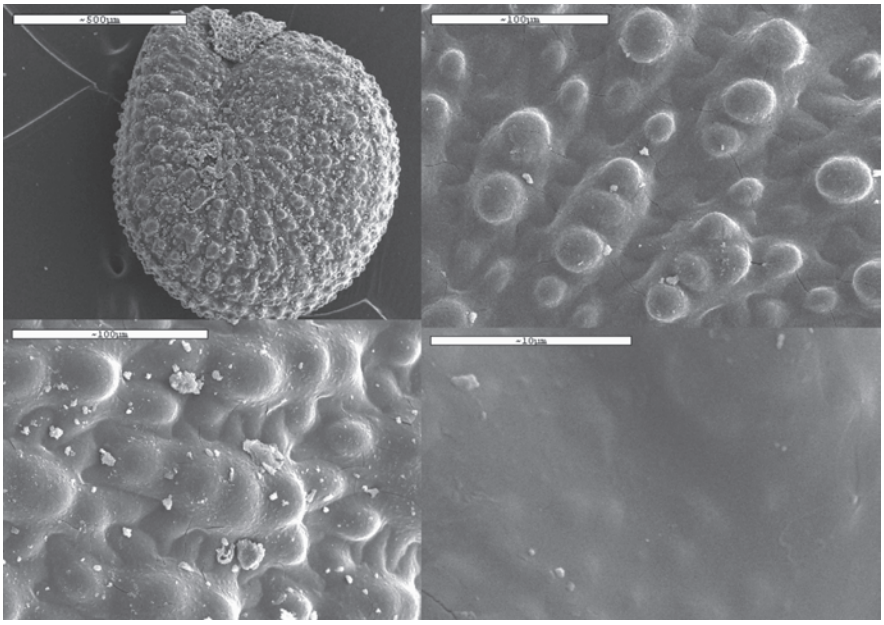

Fig. 2. SEM of *Portulaca oleracea* seeds (source – T38, T40).

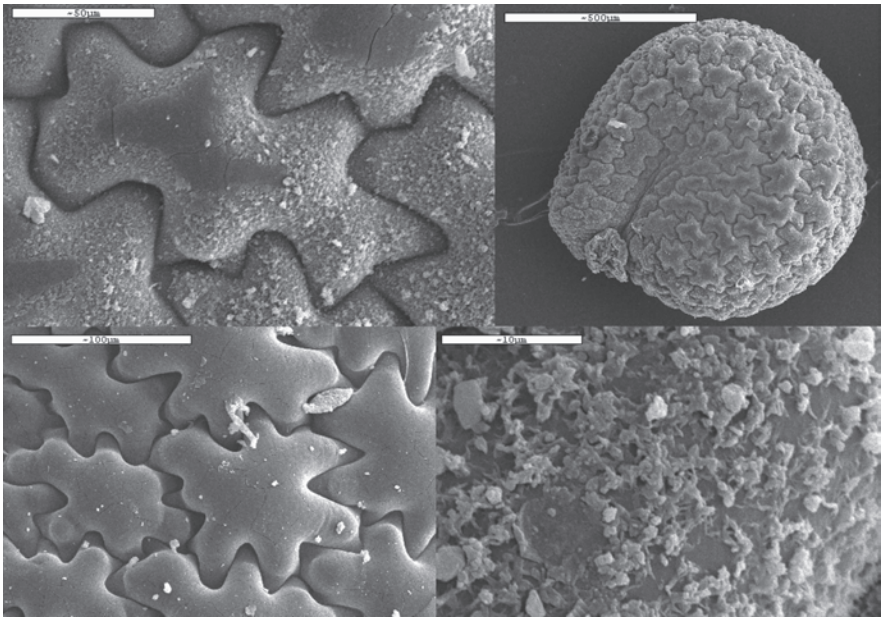

Fig. 3. SEM of *Portulaca nicaraguensis* seeds (source – T32, T34).

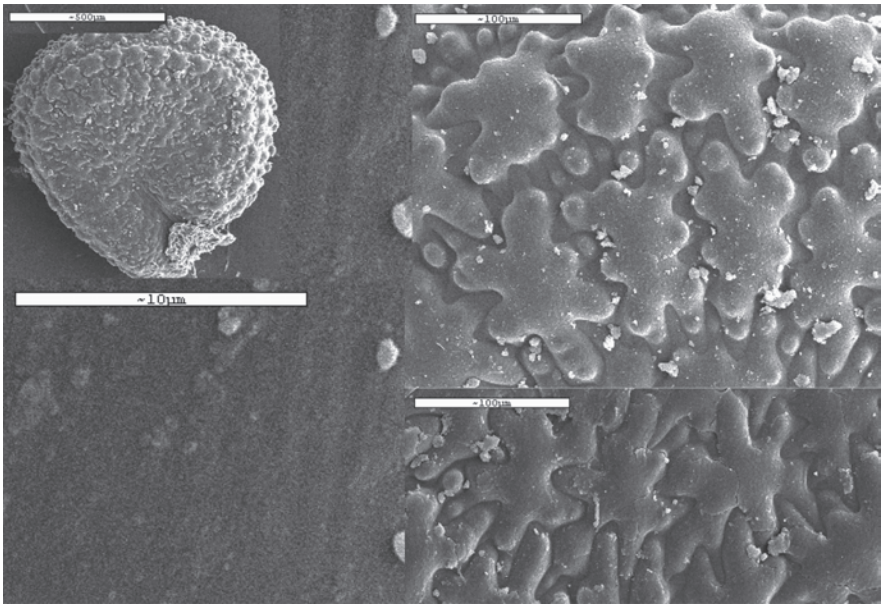

Fig. 4. SEM of *Portulaca granulato-stellulata* seeds (source – T04).

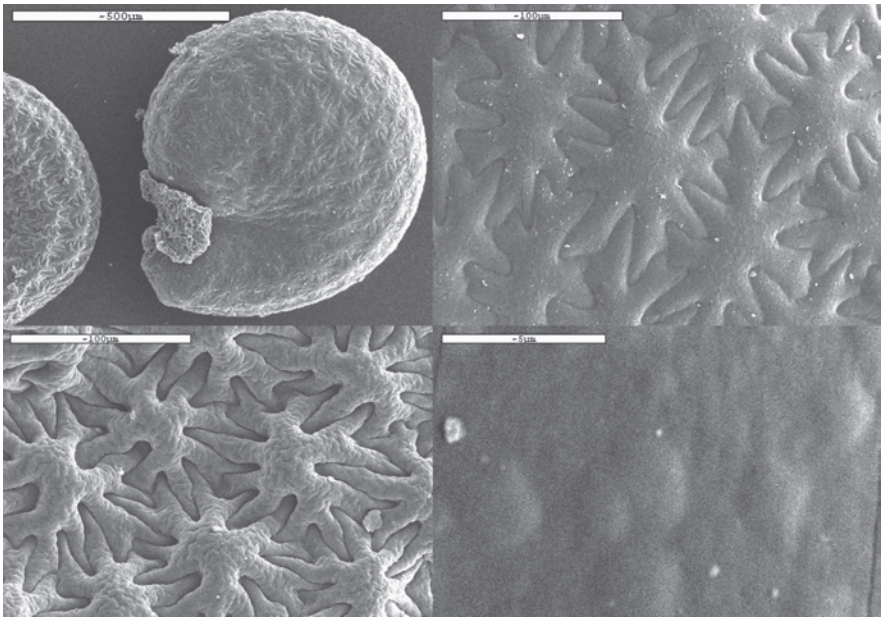

Fig. 5. SEM of *Portulaca nitida* seeds (source – T14).

Portulaca granulato-stellulata (Poelln.) C. Ricceri & P.V. Arrigoni (named *Portulaca oleracea* L. subsp. *granulato-stellulata* (Poelln.) Danin & H. G. Baker by DANIN & al. 1978). Fig. 4.

Portulaca nitida (Danin & H. G. Baker) C. Ricceri & P.V. Arrigoni (named *Portulaca oleracea* L. subsp. *nitida* Danin & H. G. Baker by DANIN & al., 1978). Fig. 5.

Portulaca africana (Danin & H. G. Baker) Danin, **stat. nov.**
Basionym and synonym: *Portulaca oleracea* L. subsp. *africana* Danin & H. G. Baker, in: A. DANIN, I. BAKER, & H. G. BAKER, *Israel J. Bot* 27: 187-189. 1978.

Portulaca tuberculata (Danin & H. G. Baker) Danin, **stat. nov.**
Basionym and synonym: *Portulaca oleracea* L. subsp. *tuberculalta* Danin & H. G. Baker, in: A. DANIN, I. BAKER & H. G. BAKER, *Israel J. Bot.* 27: 194, 1978.

Portulaca impolita (Danin & H. G. Baker) Danin, **stat. nov.**
Basionym and synonym: *Portulaca oleracea* L. subsp. *impolita* Danin & H. G. Baker, in: A. Danin, I. Baker & H. G. Baker, *Israel J. Bot.* 27: 195-196. 1978.

Portulaca stellata (Danin & H. G. Baker) Danin, **stat. nov.**
Basionym and synonym: *Portulaca oleracea* L. subsp. *stellata* Danin and H. G. Baker, in: A. DANIN, I. BAKER & H. G. BAKER *Israel J. Bot*. 27: 198-200.1978. Fig. 6

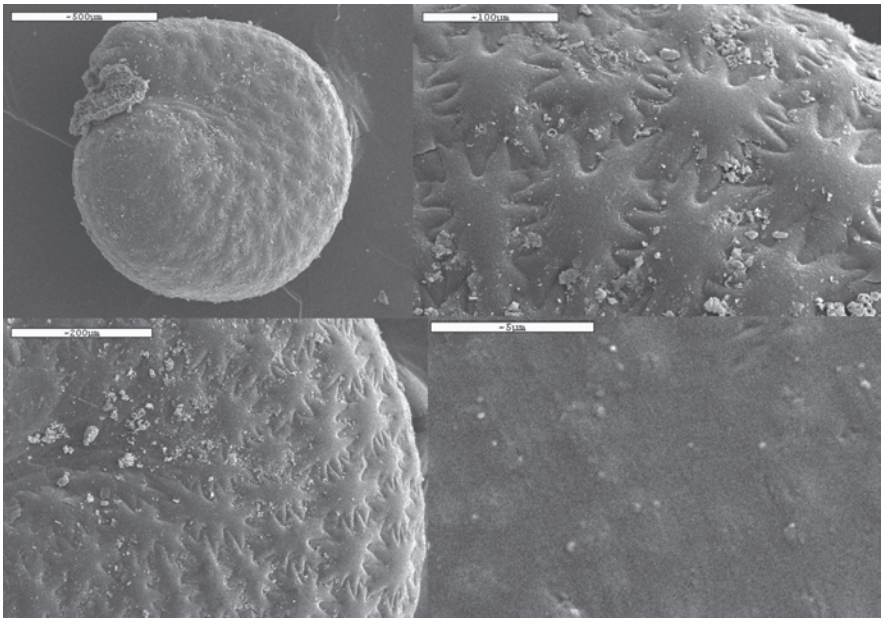

Fig. 6. SEM of *Portulaca stellata seeds* (source – LZ02).

Portulaca papillato-stellulata (Danin & H. G. Baker) Danin, **stat. nov.**
Basionym and synonym: *Portulaca oleracea* L. subsp. *papillato-stellulata* Danin & H. G. Baker, in: A. DANIN, I. BAKER & H. G. BAKER, *Israel J. Bot.* 27: 200-201. 1978.

Portulaca canariensis Danin & Reyes-Betancort **species nov.**

Species seminibus superficie impolita grisea plerumque nitore metallico predita. Ab *Portulaca impolita* (Danin and H. G. Baker) Danin cellulis latitudine 2-3 plo longiore (non isodiametricis nec asteriformibus) radii latitudine brevis (nec equalibus ad latitudine 2-3 plo longiore). Fig. 7.

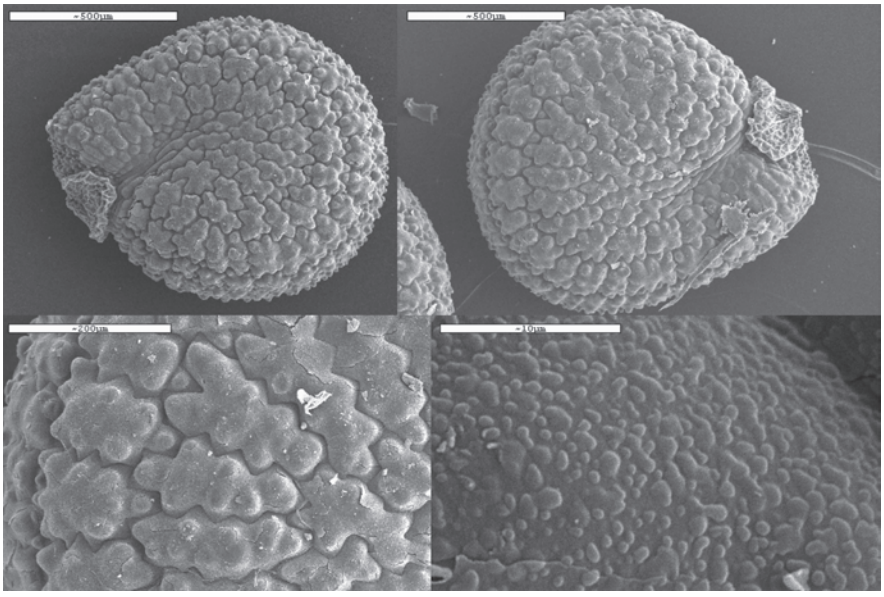

Fig. 7. SEM of *Portulaca canariensis* seeds (source – LZ02).

Type: Tenerife, Fasnia, La Hondura, 30.3.1996, *Cruz Trujillo* 39.452 (Holo - TFC; Iso - HUJ). Fig. 6.

Additional specimens seen: Canary Islands, Tenerife, El Escobonal, 24.3.1981, *Rodriguez* 12847 (TFC); Fasnia, La Hondura, 30.3.1996, *Cruz Trujillo* 39.452 (TFC); Barranco de Ijuana (Ladera S.) 250m, 12.5.1996, *Racca* 39.164 (TFC). Lanzarote, Tinajo, Casas del Isolete, 24.4.1996, *Reyes-Betancort* 40.328 (TFC).

Contrary to the situation of all the other taxa of *Portulaca* in the Canary Islands, *P. canariensis* grows in habitats that are not much disturbed. Most of our specimens were collected in the the Inframediterranean desertic-xeric arid-semiarid bioclimatic belts, sensu RIVAS-MARTINEZ & al. (1993).

Chromosome counts

The only sample which was successfully germinated and provided root tips worth for chromosomes count in La Laguna was T30. It is a sample of *Portulaca nicaraguensis* and the number of chromosomes found was 18, as in the previous counts (DANIN & al., 1978). The count in Berlin of sample T32 from Los Christianos

(*P. nicaraguensis*) gave 18 chromosomes, T41 from Arafo (*P. granulato-stellulata*) gave 36 chromosomes, T52 from Orotava (*P. nitida*) gave 36 chromosomes, T44 from Fasnia (*P. oleracea*) gave 54 chromosomes. All these counts are in vallaccord with our previous counts (DANIN & al. 1978).

Seed surface in offspring

The results of raising F1 seeds from parent material collected in Tenerife and raised there in a greenhouse are listed in Table 1. Unfortunately, samples No. T04, T25, T32, T34, and LZ02 did not germinate or did not develop to produce seeds. Checking again the results of similar F1 raising of our 1978 material revealed 100% inheritence of seed surface characters in one population of *P. nicaraguensis* (from Nicaragua), one population of *P. nitida* (from California), two populations of *P. granulato-stellulata* (from Nicaragua and from Israel), and two populations of *P. papillato-stellulata* (from Palm Springs and from Berkeley in California).

Species	Locality	Seeds counted	Seeds of the same species
P. granulato-stellulata	Santa Cruz	0	0
P. nitida	San Andres	33	33
P. granulato-stellulata	Bajamar	25	25
P. nitida	Buena Vista del Norte	37	37
P. nicaraguensis	Guaza	0	0
P. nicaraguensis	Los Cristianos	0	0
P. nicaraguensis	Playa de la Arena	0	0
P. oleracea	Las Eras	6	6
P. oleracea	Escabonal	8	8
P. canariensis	Timanfaya, Lanzarote	0	0

Table 1. Summary of offspring seed counts in populations of *P. oleracea* complex from the Canary Islands.

DISCUSSION

The first experiment of raising the F1 seeds from seeds collected in the field was already done for the material reported in DANIN & al. (1978) and reported again here. However, in order to double check the status of the taxa in this complex, we repeated raising plants from seeds collected in the Canary Islands. The offsprings did not pro-

duce seeds of mixed morphotypes; this property seems to be inherited. Each of the three species which became mature produced seeds which were of the same species. Seed variability in the taxa of the *P. oleracea* group and the few hybrids between taxa recognized were already discussed by DANIN & al. (1978).

When considering which level to give the taxa we discovered (DANIN & al. 1978) we had two possibilities – that suggested by Dr. P. Raven (pers. comm. 1978 and 2003) and our own consideration. In 1978 we were thinking of the common botanist, finding a plant from this group. We wanted her/him to be able to differentiate it at a certain level. The fisibility of "living with *Portulaca oleracea*" was the lightmotive. In later studies I conducted (DANIN 1981, 1990; DANIN & ANDERSON 1986) I had the feeling that our way was the right way. However, there were people who failed to understand it and sunk the subspecific taxa to the "synonymy level" (MATTHEWS & al., 1993; GEREAU, 2001). The specific level, suggested by Dr. Raven, is adopted by RICCERI & ARRIGONI (2000). This terminates the times when a collector could know what he holds in his hand without using a dissecting microscope to determine a species from the *Portulaca oleracea* group of taxa. Raising the rest of the taxa into a species level became now an inevitable step.

The results of the study of *Portulaca* species found in the Canary Islands, and in particular the occurrence of *P. nicaraguensis,* indicate the possibility of seed transportation by currents in the Atlantic Ocean. The previously known distribution area of *P. nicaraguensis* is from the countries near the Gulf of Mexico, from Nicaragua through southern Florida (DANIN & al., 1978; DANIN & ANDERSON, 1986). However, the increasing visits of tourists and the possible anthropogenic dispersal of seeds can not be excluded.

The discovery of the new species *P. canariensis* calls for further research. The seeds we had available while preparing the present paper, were derived from old collections and passed fumigation before their deposition in the herbarium. This might have influenced their germinability and we could not study their chromosome number. However, seed size of 1020-1114 x 880-1000 ¼m may indicate a high possibility, following DANIN & al. (1978), that we deal here with a hexaploid. DANIN & al. (1978) assume that phylogenetic relationships among the taxa related to *P. oleracea* may be drawn when seed surface morphology is compared. The closest taxon to *P. canariensis* in its seed surface morphology is *P. nicaraguensis.* The epidermal cells of both have short and wide arms which interfinger with those of the neighbouring cells in a simialr way. However, *P. canariensis* surface reflects metalic sheen and has minute bumps (1-3 ¼m) seen only at high magnification (Fig. 6d). *P. nicaraguensis* is unique in the wax cover of most of its seeds (Fig. 3d) or their totally smooth surface (Fig 3c). Future research with more sophisticated methods may assist in full understanding of the actual relationships of taxa in this divers and interesting group of taxa.

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Appendix. A list of seed samples of the Portulaca oleracea group collected in the Canary Islands. Abbreviations: T = Tenerife ; GC = Gran Canaria; LZ = Lanzarote

P. nicaraguensis (Danin & M. G. Baker) Danin

T11 – Puerto Cruz, gardens, 7.10.2003, *Danin*; T17 – Las Galletas, 20.4.2002, *Serna Ramos* 43.630 (TFC!); T25 – Guaza, 5 km N of Los Cristianos, 10.10. 2003, *Danin*; T26 - Los Cristianos, gardens at city center, 10.10. 2003, *Danin*; T27 – Santa Cruz, gardens near Carrefour Mall, 12.10. 2003, *Danin*; T30 – Puertito de Güimar, gardens near the sea, 12.10. 2003, *Danin*; T31 – Poris de Abona, gardens, 12.10. 2003, *Danin*; T32 – Los Cristianos, near the port, gardens, 13. 10. 2003, *Danin*; T33 – Playa de Las Americas, gardens, 13. 10. 2003, *Danin*; T34 – Playa de la Arena, gardens, 3. 10. 2003, *Danin*; T36 – Santa Cruz, 13. 10. 2003, *Reyes-Betancort*; T46 – Northern end of Punta del Hidalgo, (5-6 km NE of Bajamar), margins of an agricultural field. 16.10.2003, *Danin*; T53 – Punta del Hidalgo near the Light-Tower, beach strand 21.10.2003, *Danin*

P. granulato-stellulata (Poelln.) C. Ricceri & P. V. Arrigoni

T01 – Bajamar, crevices in sidewalk at city center. 3.10.2003, *Danin*; T02 – Bajamar, crevices in sidewalk near and above the beach cliff 4.10.2003, *Danin*; T03 – Bajamar, a hole filled with soil in sidewalk, far from sea 4.10.2003, *Danin*; T04 –Santa Cruz, a weed in an ornamental garden 4.10.2003, *Danin*; T09 – N Anaga, the north beach near Benjio 5.10.2003, *Danin*; T10 – Bajamar, crevices in a sidewalk at 1 m a.s.l. 6.10.2003, *Danin*; T11 – Puerto Cruz, gardens, 7.10.2003, *Danin*; T13 – Garanchico, roadside, 7.10.2003, *Danin*; T16 – El Medano, sea level, *Serna Ramos* 41.499 (TFC!); T18 – Santa Cruz, Plaza Concepcion, 31.4.1990, *Del Arco & Leon* 30.001 (TFC!); GC01 – Barranco de Guayadeque, 12.2.1990, *Amor & Perez de Paz* 30.562 (TFC!); T24 - El Medano, 200m W of the beach, gardens, 10.10. 2003, *Danin*; T28 – Las Caletillas, gardens, 12.10. 2003, *Danin*; T31 – Poris de Abona, gardens, 12.10. 2003, *Danin*; T35 – Los Gigantes, gardens, 3. 10. 2003, *Danin*; T37 – Santa Cruz, 13. 10. 2003, *Reyes-Betancort*; T39 – Las Eras, roadside in the village, 14. 10. 2003, *Danin & Reyes-Betancort*; T41 – Arafo, Poligono, roadside 200 m W of the beach. 15.10.2003, *Danin*; T42 – Arafo, Poligono, sewage outlet of a house the beach. 15.10.2003, *Danin*; T46 – Northern end of Punta del Hidalgo, (5-6 km NE of Bajamar), margins of an agricultural field. 16.10.2003, *Danin*; T44 – Fasnia village, a new garden watered by drip irrigation. 15.10.2003, *Danin*; T54 – Benijo (same as T09) near the beach, 21.10.2003, *Danin*; T56 – Igueste, Crevices in a walk near a house 21.10.2003, *Danin*;

P. nitida (Danin & M. G. Baker) C. Ricceri & P. V. Arrigoni

T05 – San Andres, a weed in an ornamental garden 4.10.2003, *Danin*; T06 – Igueste, 8 km NE of San Andres, crevices in a sidewalk 5.10.2003, *Danin*; T07 – Near Igueste, 7 km NE of San Andres, disturbed ground near the highway 5.10.2003, *Danin*; T12 – Icod de Los Vinos, gardens, 7.10.2003, *Danin*; T14 – Los Silos, abandoned garden, 7.10.2003, *Danin*; T15 – 1 km S of Buena Vista del Norte, gardens, 7.10.2003, *Danin*; T26 - Los Cristianos, gardens at city center, 10.10. 2003, *Danin*; T29 – Candellaria, gardens, 12.10. 2003, *Danin*; T39 – Las Eras, roadside in the village, 14. 10. 2003, *Danin & Reyes-Betancort*; T48 –Orotava, in crevices of an old road 18.10.2003, *Danin*; T49 – Orotava, a weed On a soily path in a garden 18.10.2003, *Danin*; T50 – Orotava, in crevices among tiles near the City Hall 18.10.2003, *Danin*;

T51 – Orotava, in crevices of a walk in Victoria gardens 18.10.2003, *Danin*; T52 – Orotava, in crevices of the path and wall near the Hospital 18.10.2003, *Danin*

P. oleracea L.

T20 – La Laguna, 18.10.1985, *Wildpret & al.* 23.122 (TFC!); T21 – Igueste de Candelaria, 16.7.1985, *Perez de Paz & al.* 24.573 (TFC!); T27 – Santa Cruz, gardens near Carrefour Mall, 12.10. 2003, *Danin*; T29 – Candellaria, gardens, 12.10. 2003, *Danin*; T38 – Las Eras, gardens, 14. 10. 2003, *Danin & Reyes-Betancort*; T40– Escabonal - La Medida, roadside, 14. 10. 2003, *Danin & Reyes-Betancort*; T43 – Arafo, Poligono, near the Beach, by an old roadside, 15.10.2003, *Danin*; T44 – Fasnia village, a new garden watered by drip irrigation. 15.10.2003, *Danin*; T45 – Fasnia village, an old garden Watered by canal irrigation. 15.10.2003, *Danin*; T46 – Northern end of Punta del Hidalgo, (5-6 km NE of Bajamar), margins of an agricultural field. 16.10.2003, *Danin*; T47 – Punta del Hidalgo beach, garden with drip irrigation 16.10.2003, *Danin*; T55 – Eastern end of Benijo, A weed in agricultural land, 21.10.2003, *Danin*

P. stellata (Danin & M. G. Baker) Danin

T08 – Roque de Bodega, a weed in an ornamental garden 5.10.2003, *Danin*; T21 – Igueste de Candelaria, 16.7.1985, *Perez de Paz & al.* 24.573 (TFC!)

P. canariensis Danin & Reyes-Betancort

T19 – El Escobonal, 24.3.1981, *Rodriguez* 12.847 (TFC!); T22 – Barranco de Ijuana (Ladera S.) 250m, 12.5.1996, *Racca* 39.164 (TFC!); T23 – Fasnia, La Hondura, 30.3.1996, *Cruz Trujillo* 39.452 (TFC!); LZ01 – Tinajo, Casas del Islote, 24.4.1996, *Reyes-Betancort*, 40.328 (TFC); LZ02 – Timanfaya, Halcones, 29.2.2002, *Cruz Trujillo* (TFC).

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