Potential Sources of Resistance to Fusarium Wilt and Powdery Mildew in Melons

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Abstract. In total, 139 *Cucumis melo* accessions were evaluated for resistance to races 0, 1, and 2 of *Fusarium oxysporum* fsp. *melonis* and 127 accessions were evaluated for resistance to races 1 and 2 of *Sphaerotheca fuliginea*. In addition, seven *C. melo* wild relatives were also tested. Artificial inoculations were performed and plants were scored for presence or absence of symptoms. The screening revealed that sources of natural resistance to these fungi are limited. However, several sources of resistance were found in *C. melo* accessions. Thus, the accession 'CUM-334' from Tajikistan has shown resistance to the three races of *F. oxysporum* fsp. *melonis*, behaving similarly to the melon inbred line 'MR1'. Two accessions of *C. melo* var. *conomon*, 'CUM-190' and 'Shiroubi Okayama', from Japan, were resistant to races 0 and 1 and twelve accessions were resistant to races 0 and 2. Intra-specific variability for resistance to powdery mildew in *C. melo* was found to be poor. Nevertheless, six Spanish cultivars and the accessions 'TGR-1551', 'CUM-313', and 'CUM-129' were resistant to races 1 and 2 of *S. fuliginea*.

Melon is a vegetable widely cultivated in warm climates around the world. World melon production was 21,727,422 × 10⁶ t in 2002. In total, 2,961,300 × 10⁶ t of melons have been harvested in 2002 in Europe, where most of the melon crops are grown in the Mediterranean area. Turkey and Spain have the highest melon production.

Several fungal diseases affect melon crops, decreasing yield and forcing intensive use of chemical sprays. Control based on genetic resistance of the host plant is preferred as long as sources of resistance are available to develop resistant cultivars. Indeed, this control strategy may help to reduce the large amount of chemicals normally used in melon crop production. The two most important fungal pathogens affecting melon crops around the world are *Fusarium oxysporum* fsp. *melonis* (L & C) Snyder & Hansen and *Sphaerotheca fuliginea* (Schlecht.: Fr.) Poll.

Fusarium oxysporum fsp. *melonis* (*Fom*) is one limiting factor for melon production worldwide (González-Torres et al., 1988; Martyn and Gordon, 1996; Mas et al., 1981). Four races of this pathogen have been described: 0, 1, 2, and 1-2 (Mas et al., 1981; Risser et al., 1976). Different resistance genes to *Fom* have been described

in melons (Mas et al., 1981; Risser, 1973; Zink and Gubler, 1985; Martyn and Gordon, 1996) and commercial melons carrying resistances to *Fom* races 0, 1, and 2 have been developed. Most of those commercial melons belong to 'Galia' or 'Cantaloupe' types and only a small number of different melon types carry such *Fom* resistances. Searching for diversification in the resistance sources is always desired to develop more durable resistant cultivars.

Regarding *S. fuliginea* the situation is quite different. Different races of *S. fuliginea* have been described since the development of the first resistant cultivar, namely 'PMR-45' (Jagger and Scott, 1937). Interaction between powdery mildew strains and melon lines is very clear and several lines can be used as differential hosts to define new races (Pitrat et al., 1998). In fact, nine *S. fuliginea* races have been already described in melons (McCreight, 2002). There are many reports about powdery mildew resistance (e.g., Epinat et al., 1993; Floris et al., 1995; Harwood and Markarian, 1968; Kenigsbuch and Cohen, 1989, 1992; McCreight et al., 1987) but the races have not always been clearly indicated and very few allelism tests have been carried out (Pitrat et al., 1998). And, although the resistant cultivars are extremely effective at protecting plants, a race succession rapidly takes place and other minor races become predominant (Hosoya et al., 2000). Thus, only a few hybrids, mostly of 'Galia' type, carry resistance to races 1, 2, and 5 (the most common races in Europe). New alternative sources conferring a more durable resistance are desired.

The objective of this work was to search for novel sources of resistance to *Fom* and *S. fuliginea* in *C. melo* germplasm collections and wild relatives.

Plant material. In total 139 accessions of *C. melo* were evaluated for resistance to races 0, 1, and 2 of *Fom* and 127 for resistance to races 1 and 2 of *S. fuliginea*. Eighty-eight accessions were evaluated against both pathogens. These included accessions untested against the two pathogens and some *C. melo* genotypes for which resistance has previously been reported that were used as controls. The latter included the French accessions, 'Charentais T' susceptible to all *Fom* races, 'Charentais Fom-1' resistant to races 0 and 2 of *Fom* and 'Charentais Fom-2' resistant to races 0 and 1 of *Fom* and the accessions 'PMR-45' resistant to race 1 and 'WMR-29' resistant to races 1 and 2 (France) of *S. fuliginea*. Moreover, seven accessions of *C. melo* wild relatives (*C. myriocarpus*, *C. africanus*, *C. zeyheri*, *C. metuliferus*, *C. prophetarum*, *C. anguria* var. *longipes*, and *C. anguria* var. *anguria*) were also tested. Melon accessions coming from different geographical regions were included in the analysis to cover diverse genetic sources. Special attention was given to the Iberian Peninsula and Turkey since both areas are important diversification centres of *C. melo* (Esquinas-Alcázar and Gulick, 1983). Accessions were obtained from germplasm collections maintained at CSIC-La Mayora and CITA in Spain, Çukurova University and EARI in Turkey, and IPK-Gatersleben in Germany. The accessions and their geographical origin tested are showed in Tables 1 and 2.

Mechanical inoculation and evaluation procedure. The *Fom* isolates used to prepare the inoculum were 8602 (race 0), 8703 (race 1) and 8701 (race 2), obtained from melon crops (Almería, Spain). A minimum of ten seedlings were inoculated by dipping their roots in a conidial suspension (3 × 10⁶ spores/mL) of the appropriate race for 30 s, and transplanting into plastic pots filled with a standard soil mixture (1 peat : 1 sand : 1 soil, by volume). Pots were then placed in a growth chamber at 28/20 °C (day/night) with 14 h·d⁻¹. Six seedlings per accession remained uninoculated as controls. Thirty days after the inoculation, inoculated plants were assessed for symptom severity on a 1 to 5 scale (1 = no symptoms, 2 = beginning of wilting or yellowing symptoms on leaves, 3 = leaves heavily affected, 4 = all leaves completely wilted, stem standing, 5 = dead plants). Plants scored with 1 or 2 were considered resistant, whereas plants scored with 3, 4, and 5 were considered susceptible. When all the plants from one accession were susceptible, the accession was described as susceptible. When no plant from one accession showed any symptom, a new inoculation was done to accurate the response; and if all the plants behaved as resistant in two replications the accession was classified as resistant. When in the same accession susceptible and resistant individuals were found in two replications, this accession was considered to have a heterogeneous response to the inoculation.

Controlled inoculations of races 1 (isolate SF-26) and 2 (isolate SF-38 A) of *S. fuliginea*, originally collected for melon crops (Málaga, Spain) were performed by spraying the second

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true leaf of each plant with a suspension of conidia in water with Triton X-100 (1 $\mu\text{L}\cdot\text{L}^{-1}$) containing 40,000 conidia/mL, following the procedure developed by Floris and Alvarez (1991) and used later in several experiments (Floris and Alvarez, 1996). Plants were then maintained in a growth chamber at 25 °C with 14/10 h day/night. Six plants/accession were tested with each race. Two plants of each accession remained uninoculated, as controls. After 10 to 12 d, the presence or absence of powdery mildew colonies in the sprayed leaf was recorded for each plant. Although McCreight et al. (1987) used a 1 to 5 scale for evaluating resistance, where 1 corresponded to no growth and 5 showed heavy growth and sporulation they considered resistant when no growth (class 1) of powdery mildew on true leaves was observed. Similarly, in our experiment, plants were rated susceptible when powdery mildew growth, weak or not, was observed in the inoculated leaf. When no plant from one accession showed any symptom a new replication was done to accurate the response. When all the plants behaved as resistant in two replications the accession was classified as resistant.

Results and Discussion

***Fusarium oxysporum* fsp. *melonis*.** 'Charentais T' behaved as susceptible to all isolates. The control accession 'Charentais Fom-1' was resistant to *Fom* isolates 8602 and 8701 and 'Charentais Fom-2' was resistant to *Fom* isolates 8602 and 8703 showing that these isolates belonged to *Fom* races 0, 2, and 0,1 respectively.

Although most of the accessions were susceptible to the three races, intraspecific variability in the response of the melon accessions to *Fom* was observed (Table 1). Resistance to race 1 was more uncommon than resistance to the other races since only four cultivars showed a resistant response; many accessions showed heterogeneity in their response when inoculated with race 0, race 1, or race 2 (Table 1). With the exception of the Turkish cultivar, A35 (ref. 23), that showed a heterogeneous response to race 1 and susceptibility to race 0, all the accessions showing resistance/heterogeneity to race 2 or to race 1 were also resistant/heterogeneous to race 0 (Table 1).

Only one accession of *C. melo*, 'CUM-334' coming from Tajikistan has shown resistance to the three races. Until now, only the accession MR1, an inbred line coming from PI-124111 (Thomas, 1986), showed resistance to races 0, 1, and 2 of *Fom*. Such resistance seems to be conferred by the genes *Fom-1* and *Fom-2* (Zink and Thomas, 1990). 'CUM-334' is a local cultivar provided by the IPK (Gatersleben, Germany); is then a novel melon accession resistant to the most well known races of this pathogen. Further studies will determine the genetic basis of the *Fusarium* wilt resistance carried by this accession. Fruit are globular shaped with ribs, yellow-greenish skin with specks and stripes, medium sized (1.0 kg), of white flesh colour. Based on its fruit features 'CUM-334' could be an adequate resistance donor to a broad range of melon types.

Two accessions showed a heterogeneous

response to the three races: some plants of the Russian accession 'Komsomolka' and the Spanish 'ANC-57' died and some did not regardless of the race of *Fom* used in the inoculations.

The Russian melon accession 'Korça', the Italian 'Cucumarazzo', three Turkish accessions 'Ananas' (ref. 4), 'A24' (ref. 16), and 'B34' (ref. 51), and the Spanish accessions 'Amarillo Cás-cara Pinta', 'Amarillo Manchado', 'Banda de Godoy', 'El Encín 4078', 'Madura Amarilla', 'Tortuga', and 'Piel de sapo M' showed a resistant response when inoculated with races 0 and 2 of *Fom*. It is interesting to emphasize that six of these seven Spanish accessions were collected from the same area in southwestern Spain (Extremadura), being local varieties growing in that area for many years. Although their fruit types can be quite different, the *Fusarium* wilt resistance they possess likely has the same genetic origin. The fungus has been in the area for many years and only the cultivars carrying genetic resistance have survived. The successive reproduction made by growers of the naturally selected material has resulted in the improvement of these old cultivars.

Two of the tested accessions of *C. melo* var. *conomon*, 'CUM-190' and 'Shiroubi Okayama', both coming from Japan, were resistant to races 0 and 1. The existence of resistance to races 0 and 1 of *Fom* in several accessions of *C. melo* var. *conomon* has been reported previously (Pitrat et al., 1998, 2000). Two more accessions of this taxon showed resistance ('Freeman's cucumber' or heterogeneity ('Kogane Nashi Makuwa') when inoculated with race 0 and a heterogeneous response was observed against the race 1. However, Paris et al. (1993) reported that resistance to races 0 and 1 in 'Freeman's cucumber' was conferred by the gene *Fom-2*. These results were later confirmed by Burger et al. (2002) who also demonstrated the use of molecular markers for the selection of *Fom-2* in this accession. A lack of uniformity in the seeds of 'Freeman's cucumber' we used in this work could explain the heterogeneity in the response to race 1 of *Fom*.

Resistance to race 0 was found in the accessions 'Muchianskaja' and 'Muchanesvi' ('CUM-375') from Georgia, 'CUM-355' from Iraq, 'B14' (ref. 34) from Turkey, and 'SE-2811-1C' from Spain. The Turkish accessions 'B09' (ref. 30) resistant to race 1, 'C02' (ref. 60) resistant to race 2, and 'CUM-85', from Greece, resistant to race 2 showed heterogeneity when inoculated with race 0.

Mechanical inoculation of the selected genotypes showed that it is very difficult to find resistance to the three races of *Fom*. Intraspecific variability for resistance to one or two races was found, with resistance to races 0 and 2 more common than resistance to races 0 and 1. A significant number of accessions showed a heterogeneous response to different races (Table 1) that may be explained by a lack of sufficient selection for resistance during their original development. These accessions are, however, potential sources of resistance and, therefore, additional studies are required to determine whether their heterogeneous response to infection is the result of intra-accession genetic variability. Testing several inoculation

procedures and the analysis of progenies from self-pollinated resistant plants should clarify the situation.

No infection of *Cucumis* spp. was expected since *Fom* is described as affecting mostly *C. melo*. However, susceptibility to the three races has been found in the accessions of *C. prophetarum* and *C. anguria anguria*. Inoculation of *C. myriocarpus* with races 1 and 2 resulted in a heterogeneous response, several inoculated plants died and some did not.

***Sphaerotheca fuliginea*.** The control accession 'PMR-45' showed resistance to race 1 and susceptibility to race 2 of *S. fuliginea*. 'WMR-29' showed resistance to both races, which confirmed that the isolate used in the inoculations belonged to the previously described race 2 (France origin) following Pitrat et al. (1998). Sixteen accessions showed resistance to race 1. From them, only 10 accessions were also resistant to race 2 (Table 2).

Intraspecific variability for resistance to *S. fuliginea* in *C. melo* was found to be poor. Most of the resistance to race 2 was found in Spanish cultivars. Thus, when plants of the Spanish accessions 'ANC-29', 'ANC-44', 'ANC-46', 'ANC-57', 'Ariso', 'CMC-23', and 'Negro de Ardales' and the accessions 'TGR-1551' from Zimbabwe, 'CUM-313' from Libya and 'CUM-129' from Turkey were inoculated with races 1 and 2 of *S. fuliginea*, a resistant response to both races was observed.

The accessions 'Kogane Nashi Makuwa' from Japan, 'Short internode cantaloupe', from the U.S.A., 'China-3' from China, and the Spanish cultivars 'ANC-68', 'Negro de Zaragoza', and 'ANC-42' were resistant to race 1 but susceptible to race 2.

Most of the Spanish cultivars showing resistance to race 1 or to races 1 and 2 are from the provinces of Cádiz and Málaga, in the South of Spain; like resistance to *Fusarium* wilt, the resistance to *S. fuliginea* in those cultivars may have the same origin. The response of 'ANC-57' is notable because of its behaviour against the two pathogens and its fruit characteristics. This accession was resistant to races 1 and 2 of *S. fuliginea* and also showed a heterogeneous response when inoculated with the races 0, 1, and 2 of *Fom* which could be explained by a lack of selection for resistance to *Fom* when self-pollinated. Fruit have yellow smooth skin, white flesh and high soluble solid content. All those features make this accession an interesting candidate to be used as the donor for powdery mildew and *Fusarium* wilt resistance in breeding programs aimed at the improvement of yellow type melon cultivars, which is one of the most important types growing in the Mediterranean area and exported to all Europe. However the origin of the heterogeneity showed by this cultivar against *Fusarium* wilt should be confirmed to eliminate environmental causes.

Special attention should be given to 'TGR-1551', resistant to both races of *S. fuliginea*, which was previously reported as resistant to infections by *Cucurbit yellowing stunt virus* (genus *Crinivirus*, family *Closteroviridae*) (López-Sesé and Gómez-Guillamón, 2000) to its natural vector, the sweetpotato whitefly *Bemisia tabaci* Gennadius

Table 1. Response of melon accessions and wild relatives to mechanical inoculation with *Fusarium oxysporum* races 0, 1, and 2. (r = resistant; s = susceptible; h = heterogeneous response).

Melon			Race			Melon			Race			Melon			Race		
accession	Origin		0	1	2	accession	Origin		0	1	2	accession	Origin		0	1	2
CUM-481	Albania		s	s	s	CA-101084-1C	Spain		s	s	s	A35 (ref. 23)	Turkey		s	h	s
Manitoba	Canada		h	h	s	Caña dulce	Spain		s	s	s	A37 (ref. 24)	Turkey		s	s	s
China-3	China		s	s	s	CMC-1	Spain		h	s	r	B09 (ref. 30)	Turkey		h	r	s
CUM-496	Croatia		h	s	h	CMC-23	Spain		s	s	h	B14 (ref.34)	Turkey		r	s	s
CUM-378	Georgia		s	s	s	CMC-7	Spain		h	s	r	B34 (ref. 51)	Turkey		r	s	r
Muchanesvi (CUM375)	Georgia		r	s	h	Común	Spain		s	s	s	C02 (ref. 60)	Turkey		h	s	r
Muchanesvi (CUM376)	Georgia		s	s	s	De la Marina	Spain		s	s	s	35	Turkey		h	s	h
Muchianskaja	Georgia		r	h	h	Del País	Spain		s	s	s	38	Turkey		s	s	s
Enfurter Netzmelone	Germany		s	s	s	El Encín 064	Spain		s	s	s	Sereflikochisar	Turkey		s	s	s
Opalkugel	Germany		s	s	s	El Encín 4078	Spain		r	s	r	Simama	Turkey		s	s	s
Kreta	Greece		s	s	s	Escrito	Spain		s	s	s	Kirkagaç	Turkey		r	h	h
CUM-85	Greece		h	s	r	Esento	Spain		s	s	s	Bender Surprise	U.S.		s	s	s
Menouvi moup.	Greece		s	s	s	Franceset	Spain		s	s	s	Golden Champlain	U.S.		s	s	s
Sudbalkan-1	Greece		s	s	s	Hidalgo	Spain		s	r	s	Stutz Supreme	U.S.		h	s	h
Ambrus-Fele	Hungary		s	s	s	Inver	Spain		s	s	s	Short Internode.	U.S.		s	s	s
PI-414723	India		s	s	s	Invernizo	Spain		s	s	s	Nanaskaana	U.S.		s	s	h
CUM-355	Iraq		r	h	h	Inverno	Spain		s	s	s	PMR-45	U.S.		s	s	s
Freeman's cucumber	Israel		r	h	s	Loperano	Spain		s	s	s	WMR-29	U.S.		s	s	s
Carosello	Italy		s	s	s	Madura Amarilla	Spain		r	s	r	Control					
Carosello Lungo Barese	Italy		s	s	s	Maduro Negro	Spain		h	s	h	Charentais Fom-1	France		r	s	r
Cucumarazzo	Italy		r	s	r	Melón de olor	Spain		h	s	h	Charentais Fom-2	France		r	r	s
CUM-484	Italy		s	s	s	Mochuelos	Spain		s	s	s	Charentais T	France		s	s	s
Melone, Mlune	Italy		s	s	s	Mollerusa-1	Spain		s	s	s						
CUM190	Japan		r	r	s	Mollerusa-2	Spain		s	s	s						
Kogane Nashi	Japan		h	h	s	Mollerusa-7	Spain		s	s	s	Wild species					
Shiroyubi okayama	Japan		r	r	h	Moscatel	Spain		s	s	s	<i>C. myriocarpus</i>	Unknown		r	h	h
Fagus (CUM313)	Libya		h	s	h	MUC-36	Spain		s	s	s	<i>C. africanus</i>	Unknown		r	r	r
Khlar (CUM294)	Libya		h	s	h	Negro Ardales	Spain		s	s	s	<i>C. zeyheri</i>	Unknown		r	r	r
CUM-338	Mongolia		h	s	s	Negro Zaragoza	Spain		s	s	s	<i>C. metuliferus</i>	Unknown		r	r	r
CUM-263	Mongolia		h	s	r	Negros	Spain		s	s	s	<i>C. prophetarum</i>	Unknown		s	s	s
Melba	Poland		s	s	s	Pedroso	Spain		s	s	s	<i>C. anguria longipes</i>	Unknown		r	r	r
Oliwin	Poland		s	s	h	Piel de Sapo H	Spain		s	s	s	<i>C. anguria anguria</i>	Unknown		s	s	s
M-56197	Portugal		s	s	s	Piel de Sapo M	Spain		r	s	r						
CUM-366	Russia		s	s	s	Pinyonet	Spain		s	s	s						
Komsomolka	Russia		h	h	h	Pipa blanca	Spain		s	s	s						
Gurbek	Russia		r	h	h	Rajado	Spain		s	s	s						
Korça	Russia		r	s	r	Rochel	Spain		s	s	s						
Agostizo	Spain		s	s	s	Rochet	Spain		s	s	s						
Amarillo alargado	Spain		h	s	h	SE-2811-1C	Spain		r	h	h						
Amarillo oval tardío	Spain		s	s	s	Tempranillo	Spain		s	s	s						
Amarillo blanco piñón	Spain		s	s	s	Tendral (Huesca)	Spain		s	s	s						
Amarillo cáscara pinta	Spain		r	s	r	Tendral negro	Spain		s	s	s						
Amarillo manchado	Spain		r	s	r	Tendral temprano	Spain		s	s	s						
ANC-13	Spain		s	s	s	Tendral verde	Spain		s	s	s						
ANC-29	Spain		s	s	h	Tortuga	Spain		r	s	r						
ANC-32	Spain		s	s	s	VC-115	Spain		s	s	s						
ANC-36	Spain		s	s	s	Verde gordo	Spain		s	s	s						
ANC-37	Spain		h	s	h	CUM-333	Tajikistan		h	s	h						
ANC-42	Spain		s	s	s	CUM-334	Tajikistan		r	r	r						
ANC-46	Spain		s	s	s	Togo	Togo		s	s	s						
ANC-48	Spain		s	s	s	CUM-129	Turkestan		h	s	s						
ANC-52	Spain		s	s	s	A02 (ref.2)	Turkey		s	h	s						
ANC-57	Spain		h	h	h	Ananas (ref. 3)	Turkey		s	s	s						
ANC-68	Spain		s	s	s	Ananas (ref. 4)	Turkey		r	s	r						
Ariso	Spain		s	s	s	A06 (ref. 6)	Turkey		s	s	s						
Banda de Godoy	Spain		r	s	r	A18 (ref. 12)	Turkey		s	s	s						
Baza	Spain		s	s	s	A24 (ref. 16))	Turkey		r	s	r						
Bola de oro	Spain		s	s	s	A25 (ref. 17)	Turkey		s	s	s						
Bolas	Spain		s	s	s	A26 (ref. 18)	Turkey		s	s	s						

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(Hemiptera: Aleyrodidae) (Soria et al., 1999), to virus transmission by *Aphis gossypii* (Soria et al., 2003), to *A. gossypii* (Garzo et al., 2002) and to WMV-2 (Díaz et al., 2004). Therefore, the results obtained here emphasize the potential value of this multi-resistant melon accession as a donor of multiple disease and pest resistance for melon breeding programs.

The tested accessions of the wild species *C. africanus*, *C. prophetarum* and *C. anguria* var *anguria* showed resistance to *S. fuliginea* whatever the race used. However, the use of

these species as resistance donors to melon through traditional breeding methods is difficult because of strong sexual barriers among these species and *C. melo*. Although attempts to cross *C. melo* with other *Cucumis* species have failed (Beharav and Cohen, 1995), novel gene transfer strategies may allow their exploitation in the future (Zamir, 2001).

Sources of natural resistance to *Fom* and *S. fuliginea* in *C. melo* is limited, but some promising heterogeneous or resistant responses to both pathogens were found.

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Table 2. Response of melon accessions and wild relatives to mechanical inoculation with *Sphaerotheca fuliginea* races 1 and 2 (r: resistant; s: susceptible response)

Melon accession	Origin	Race		Melon accession	Origin	Race		Melon accession	Origin	Race	
		1	2			1	2			1	2
CUM-481	Albania	s	s	ANC-42	Spain	r	s	Verde gordo	Spain	s	s
Bulgaria	Bulgaria	s	s	ANC-44	Spain	r	r	Verdoso	Spain	s	s
Manitoba	Canada	s	s	ANC-46	Spain	r	r	CUM-333	Tajikistan	s	s
China-3	China	r	s	ANC-52	Spain	s	s	CUM-334	Tajikistan	s	s
Doublon	France	s	s	ANC-57	Spain	r	r	Togo	Togo	s	s
Muchanesvi (CUM375)	Georgia	s	s	ANC-64	Spain	s	s	CUM129	Turkestan	s	s
Muchanesvi (CUM376)	Georgia	s	s	ANC-68	Spain	r	s	Sanarcande	Turkestan	s	s
Muchianskaja	Georgia	s	s	ANC-103	Spain	s	s	Kirkagaç	Turkey	s	s
CUM-378	Georgia	s	s	Ariso	Spain	r	r	Sanjuan Pueblo	U.S.	s	s
Enfurter Netzmelone	Germany	s	s	Banda de Godoy	Spain	s	s	Short Internode	U.S.	r	s
Opalkugel	Germany	s	s	Baza	Spain	s	s	Nanaskaana	U.S.	s	s
Cantalupe Prescott	Germany	s	s	Bola de oro	Spain	s	s	Bender Surprise	U.S.	s	s
Rockford	Germany	s	s	Bolas	Spain	s	s	Golden Champlain	U.S.	s	s
Consul Shiller	Germany	s	s	CA-101084-1C	Spain	s	s	Stutz Supreme	U.S.	s	s
Kreta	Greece	s	s	Calabacero	Spain	s	s	8/85	Yugoslavia	s	s
CUM-85	Greece	s	s	Caña dulce	Spain	s	s	TGR-1551	Zimbabwe	r	r
Ambrus-Fele	Hungary	s	s	Chimo	Spain	s	s				
CUM-355	Iraq	s	s	CMC-23	Spain	r	r	Controls			
Freeman's cucumber	Israel	s	s	Común	Spain	s	s	PMR-45	U.S.	r	s
Carosello	Italy	s	s	De la Marina	Spain	s	s	WMR-29	U.S.	r	r
Carosello Lungo Barese	Italy	s	s	Del año chino	Spain	s	s				
Cucumarazzo	Italy	s	s	De Bogarra	Spain	s	s	Wild species			
CUM-484	Italy	s	s	Del País	Spain	s	s	<i>C. myriocarpus</i>	Unknown	s	s
Melone, Mlune	Italy	s	s	Escrito hocico bozal	Spain	s	s	<i>C. africanus</i>	Unknown	r	r
Melone gialle	Italy	s	s	Esento	Spain	s	s	<i>C. zeyheri</i>	Unknown	r	s
Muscat. cukordinnye	Italy	s	s	Franceset	Spain	s	s	<i>C. metuliferus</i>	Unknown	s	s
CUM190	Japan	s	s	Hidalgo	Spain	s	s	<i>C. prophetarum</i>	Unknown	r	r
Kogane Nashi Makuwa	Japan	r	s	Inver	Spain	s	s	<i>C. anguria longipes</i>	Unknown	s	s
Hyrugo Ao Shima Uri	Japan	s	s	Invernizo	Spain	s	s	<i>C. anguria anguria</i>	Unknown	r	r
Omaru Gin Makuwa	Japan			Japonés	Spain	s	s				
Shiroubi Okayama	Japan	s	s	Loperano	Spain	s	s				
Adzur	Libya	s	s	Loperos	Spain	s	s				
Fagus (CUM313)	Libya	r	r	Madura Amarilla	Spain	s	s				
CUM-338	Mongolia	s	s	Maduro Negro	Spain	s	s				
CUM-263	Mongolia	s	s	Melón secano 1	Spain	s	s				
Ananas tiger	Netherlands	s	s	Melón secano 2	Spain	s	s				
Gersney conquezar	Netherlands	s	s	Mochuelos	Spain	s	s				
M-56197	Portugal	s	s	Mollerusa-1	Spain	s	s				
CUM-366	Russia	s	s	Mollerusa-2	Spain	s	s				
Komsomolka	Russia	s	s	Mollerusa-7	Spain	s	s				
Gurbek	Russia	s	s	Moscatel	Spain	s	s				
Korça	Russia	s	s	MUC-5	Spain	s	s				
Pretoria	SouthAfrica	s	s	MUC-36	Spain	s	s				
Agostizo	Spain	s	s	Negro Ardales	Spain	r	r				
Amarillo alargado	Spain	s	s	Negro Zaragoza	Spain	r	s				
Amarillo oval tardío	Spain	s	s	Negros	Spain	s	s				
Amarillo blanco piñón	Spain	s	s	Pedroso	Spain	s	s				
Amarillo cáscara pinta	Spain	s	s	Piel de Sapo	Spain	s	s				
Amarillo manchado	Spain	s	s	Piel de Sapo H	Spain	s	s				
ANC-17	Spain	s	s	Pintasapo	Spain	s	s				
ANC-25	Spain	s	s	Pinyonet	Spain	s	s				
ANC-29	Spain	r	r	SE-2811-1C	Spain	s	s				
ANC-32	Spain	s	s	Tendral negro	Spain	s	s				
ANC-37	Spain	s	s	VC-68	Spain	s	s				
ANC-41	Spain	s	s	VC-115	Spain	s	s				

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