Juan Pablo Del Monte & Pedro Luis Aguado

Survey of the non-native plant species in the Spanish Iberia in the period 1975-2002

Abstract

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A bibliographic search was carried out to make an updated catalogue of the plant species introduced and naturalized in the Spanish part of the Iberian peninsula. The number of records reported in the period 1975-2002 amounted to 170 plant species. The results were categorized according to botanical families and geographical origin. The status of these naturalized species and their distribution within the autonomous regions of the Spanish Iberia were also studied.

Introduction

One of the issues arising from research on non-native plant species is the scope of this category. When a plant species is categorized as non-native the author refers to its presence in a geographical area that constitutes a political unit regardless of the fact that this may not be equivalent to a homogeneous territory or ecological unit. The case of Spain is a clear example of this. Two countries, Spain and Portugal, are in the Iberian Peninsula, but the Spanish nation consists not only of the Spanish Iberia but also of its overseas territories, the Balearic and Canary islands.

Nowadays, intensive trade and the constant flow of people have resulted in a large plant transfer crossing frontiers and geographical boundaries. For example, it is reported that the introduction of non-native plant species in California for the last 150 years has seen an exponential growth similar to the increase in human population (Randall & al. 1998).

During the 20th century the way in which the introduction of new plant species is regarded has changed progressively. In the first half of the 20th century only those species interfering with human activity or causing economic losses were perceived as a problem. This perception has become broader and nowadays the effect of the introduction of a new species is also related to the environment of the new site. However, in the past it was believed that non-native plants would not be able to thrive without man's help because, at equilibrium state, the land vegetation would prevent their establishment. More recently, Vitousek & al. (1997) have assessed the potential of non-native species for interacting with the composition and performance of the ecosystem and for producing ecological change.

Another remarkable aspect of the research on non-native species is the wide range of names used to refer to the fact that a plant species has been introduced in a new site. For

example, some of the epithets/names applied in the literature to non-native plants are: non-indigenous, allochthonous, exotic, alien, adventitious, invasive, naturalised, xenophyte, environmental weeds, resident, new-native, etc. However, these names are not necessarily synonymous. Depending on the context, names can mean different things. For instance, according to Tutin & al. (1964), a plant species is naturalized when"... the plant has been established in a single station for at least 25 years or is reported as naturalised in a number of widely separated localities". The epithets: 'invasive', 'non-native' and 'allochthonous' are used (Richardson & al. 2000) with this meaning, although the concepts may not be exactly equivalent.

According to Richardson & al. (2000) the succession of stages following the arrival of a non-native species are: I) introduction, II) naturalization, III) invasion, and IV) incorporation. In the introduction stage –essentially its arrival- the species crosses geographical boundaries with the help of an introducing agent –usually man- and succedes in establishing a new adult population which survives. In the event of failure the species then disappears (ephemeral species). The second stage, 'naturalization', is reached when the species overcomes biotic and abiotic barriers to survival and reproduction. Subsequently, the initial population reproduces and increases its size and forms a self-perpetuating colony. The next stage, 'invasion', is characterised by the development of new self-perpetuating colonies and their dispersal to distant sites. The final stage of this process is the incorporation of the new species into the local flora, sometimes in strong competition with one or more native species. However, the sequence outlined above does not always occur as described. Not all the non-native species become invasive, neither are all the invasive species non-native. In fact, only a small number of the non-native species succeed and subsequently spread across a large area, provided that man does not act in opposition to this process. Besides, the character of being invasive can occur in different degrees - more invasive, less invasive.

Models for assessing the invasive capacity of a particular plant species are available currently.

Studies conducted by several authors have shown the importance of non-native species in different countries. According to Fournier (1961), the number of exotic plant species naturalized in France was 479. Westbrooks (2003) reported for the USA about 3800 non-native species, of which 1450 were weeds. In Australia, Virtue & Panetta (2003) reported nearly 300 species naturalized in the period 1971 to 1995. In the case of New Zealand, Williams (2003) estimated the rate of naturalization at 14 species per year. For our neighbouring country Portugal, Almeida & Freitas (2001) found that 184 non-native species were introduced there in the period between 1974 and 1999.

According to Wittenberg & Cock (2001), problems subsequent to the introduction of non-native species can be prevented by the following measures: I) prevention II) early detection, III) eradication, and IV) control. If a non-native species overcomes the prevention measures and its introduction starts accidentally, it is crucially important that this fact is detected early to be able to achieve the eradication or control of the species.

In the case of early detection, an up date to review of what is known about the occurrence of the plant is useful not only to study the species spread - whether it is in terms of area distribution or speed - but also to establish intervention measures. Some of the data that should be included in such a review are the following:

- Date of the first record, not forgetting that the actual arrival date will usually have been prior to this.
- Area concerned.
- Extent and/or intensity of its occurrence, particularly if the introduction has been, for instance, through the use of an allochthonous plant species for land restoration, or by seed contamination. Plant occurrence details are important because, when there is a large amount of plant propagules, the chances of preventing invasion are very low for natural plant communities (Randall & al. 1998).
- Distribution and associated problems

The work presented here is set within the aforementioned research field. The aim of the work was to produce an updated catalogue of the non-native plant species recorded for the Spanish Iberia in the period 1975 to 2002 and to analyse the distribution pattern.

Materials and methods

This study has been restricted in terms of geographical area to the Spanish Iberia, hence species native to Portugal and present in Spain are reported as non-native plants. In terms of time, the limits of the work are given by the period chosen: 1975 to 2002, a period similar to the one studied by Almedia & Freitas (2001) in Portugal.

In this work the occurrence of a non-native plant species was recorded provided that the first record for Spain was dated within the period 1975-2002. An exception to this rule was made in two cases when the only previous information about the species occurrence in Spanish Iberia was: I) herbarium specimens dated in the first 25 years of the XX century and not reported again until 50 years later, and II) species reported as cultivated plants. Non-native species present as garden plants were not included in our catalogue if no other evidence of their presence in Spain as scaped or naturalised was found.

A bibliographic search was conducted in the records of non-native spermatophytes present in the Spanish Iberia and reported as recently-introduced or naturalized. The data concerning scientific name, first record date, record author, occurrence area -autonomous region -, origin and status, if available, were compiled. The search was carried out in botanical Journals and other related literature using as keywords the accepted scientific names and synonyms. For the record date, the date of the first record was used instead of the date of introduction of the species, on the grounds that this is unknown.

The search conducted for this work covered most of the Spanish botanical Journals and Floras (see Appendix 2). The authors cannot affirm categorically that the compilation is fully comprehensive because the literature is very dispersed. Unintentional omissions of records may have occurred.

Once the compilation of data was completed, the records of non-native species were organised according to botanical family, geographical origin and area of detection (autonomous region) in the Spanish Iberia. In some cases, the origin of the species is found in two or more geographical areas, and in others the first record was reported in several regions simultaneously. In these cases, the origins and detection areas were separately recorded in our work.

Table 1. Families with less than 2% of the non-native species introduced in Spain in the period 1975-2002. Between brackets, number of new species reported for Spain.

Amaranthaceae (3)	*Amaryllidaceae* (1)	*Apiaceae* (3)	*Asclepiadaceae* (1)	*Balsaminaceae* (2)
Betulaceae (1)	*Boraginaceae* (3)	*Cactaceae* (2)	*Caryophyllaceae* (2)	*Chenopodiaceae* (3)
Commelinaceae (2)	*Convolvulaceae* (3)	*Cuscutaceae* (1)	*Cyperaceae* (3)	*Elatinaceae* (1)
Gentianaceae (1)	*Haloragaceae* (1)	*Hyacinthaceae* (1)	*Hydrocharitaceae* (2)	*Hydrophyllaceae* (1)
Iridaceae (2)	*Juncaceae* (2)	*Lamiaceae* (1)	*Liliaceae* (1)	*Malvaceae* (3)
Martyniaceae (1)	*Nyctaginaceae* (1)	*Nymphaceae* (1)	*Onagraceae* (2)	*Orchidaceae* (1)
Orobancheaceae (1)	*Phormiaceae* (1)	*Primulaceae* (1)	*Ranunculaceae* (1)	*Rosaceae* (1)
Sapotaceae (1)	*Saxifragaceae* (1)	*Scrophulariyaceae* (1)	*Tetragoniaceae* (1)	*Thymelaeaceae* (1)
Valerianaceae (1)	*Verbenaceae* (1)			

Results

The catalogue of the non-native plant species introduced in Spain in the period 1975-2002 is given in Appendix 1. The results of the statistical analysis performed to provide a summary of this catalogue are shown in Figures 1, 2 and 3 and in Table 1.

The results of this work show that the number of non-native species introduced in Spain from 1975 to 2002 is 170, equivalent to a rate of 6 new species per year. This value is close to the one reported by Almeida & Freitas (2001) for Portugal: 184 new species in the period 1974-1999.

The non-native species reported in our catalogue belong to 50 botanical families. Most of the reported species are from only three families: *Asteraceae*, with 37 species (⇔ 22% of the total number of introduced species), *Poaceae*, with 34 species (⇔ 21%), and *Solanaceae*, with 10 species (⇔ 6%) of which 9 are in the genus *Solanum*. The *Solanum* genus exhibits the highest frequency of introduced species. The analysis of the results for botanical families is consistent with the data reported by Almeida & Freitas for Portugal.

The families most represented there were also *Asteraceae* and *Poaceae*, and *Solanaceae* was 4th in the ranking. Relative frequencies of the different families reported in this work are shown in Figure 1. Families exhibiting frequencies lower than 2% - overall representing 37% of the introduced species- are categorized as 'Other families' in Figure 1.

However, they are separately reported in Table I with figures for the respective number of new species. There were 27 families with only 1 introduced plant species.

Figure 2 shows the analysis of the results as a function of the species origin. The most frequent origin is America, representing 46% of the introduced species. Among the areas closer to Spain are North Africa (10 species), the Mediterranean area (13 species) and Portugal (8 species).

As regards the status of the species compiled in this work, the most frequent category is weeds. In fact, 58% of the species pool are recognized as weeds in the literature (Holm & al. 1979) and/or in their areas of distribution in Spain. Notable weed genera listed in our catalogue are: *Amaranthus, Amsinckia, Leptochloa, Solanum, Heteranthera*, etc. It should be noted that some of the species categorized as weeds were deliberately introduced in

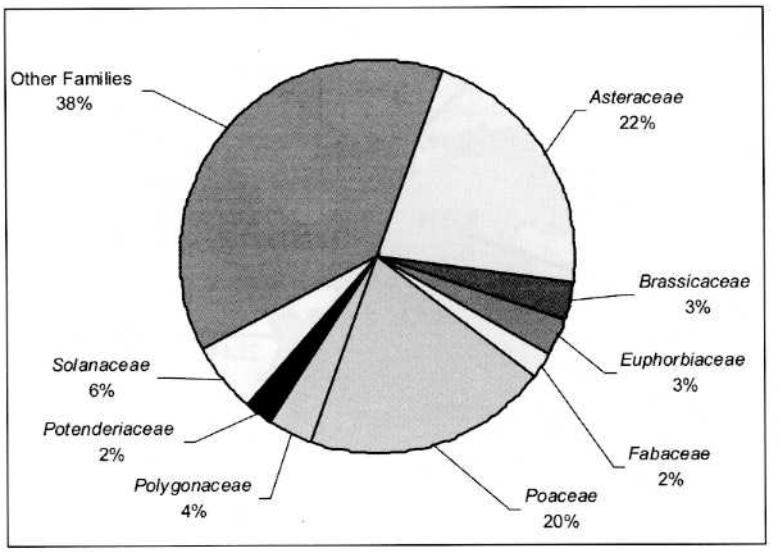

Fig. 1. Relative frequency (%) of non-native species introduced in Spain in the period 1975-2002, categorized according to botanical family.

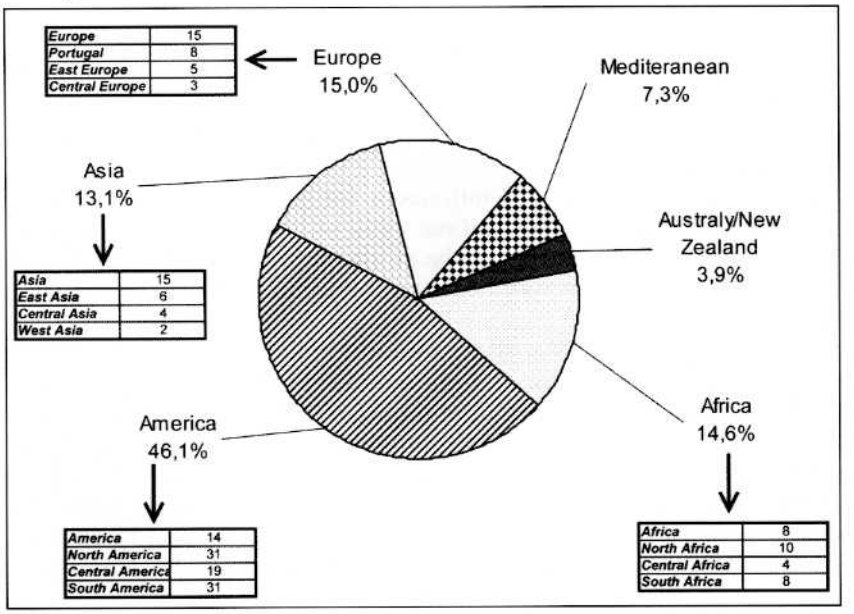

Fig 2. Relative frequency (%) of non-native species introduced in Spain in the period 1975-2002, as a function of the species origins. The adjacent tables show the number of new species allocated to geographical areas.

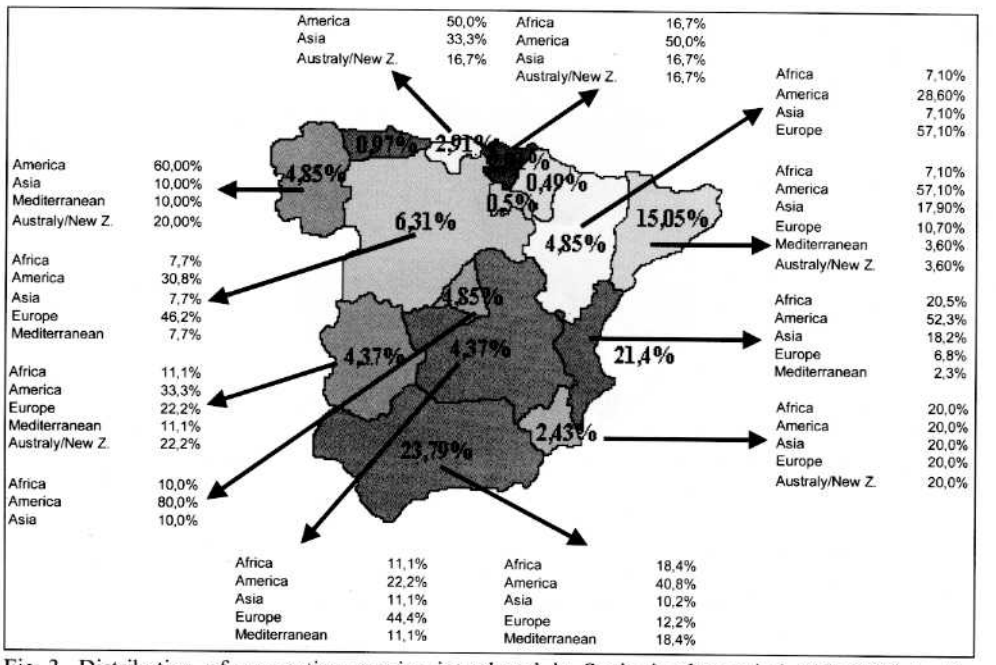

Fig 3. Distribution of non-native species introduced in Spain in the period 1975-2002 in the autonomous regions. The values on the map correspond to relative frequencies over the total number of introduced species. The adjacent tables show the relative frequencies of the species origins.

Spain by man because of their economic applications, whether as ornamental plants (for instance, *Reynoutria japonica* Houtt), green forage (*Atriplex semibaccata* R. Br.), green manure (*Phacelia tanacetifolia* Bentham), or for land reclamation (*Chloris virgata* Swartz, *Chloris gayana* Kunth).

Non-native species deliberately introduced for cultivation and then accidentally naturalized in Spain represent 27,5% of our catalogue. The reason for their introduction was their economic application, that can be divided into: ornamental uses (31 species ⇔ 19%), land reclamation (14 species ⇔ 8,5%) and others (5 species ⇔ 3%). Some of these species had several uses.

There is also the case of introduced species that have a very restricted area of distribution as naturalized species, for example, *Narcisus calcicola* Mendonça and *Androsace helvetica* (L.) All. Their distribution is assumed to be a result of their natural dispersal capacity.

The relative frequencies of the places reported as first records for the Spanish Iberia are given in Figure 3. The tables presented as attachments to Figure 3 show the relative frequencies of the species origins. From this Figure 3 it can be inferred that the autonomous regions most affected – in terms of relative frequencies – by the introduction of non-native species are Andalucia (24,9%), Valencia (18,9%) and Catalonia (16,4%).

Conclusions

The results of this work show that the number of non-native species introduced in the

Spanish Iberia and subsequently reported as naturalized in the period between 1975 and 2002 is 170, of which 46% come from America. 58% are recognized weeds. The coastal regions in the East and South register the highest number of non-native species reported for the Spanish Iberia, accounting for 62% of the introduced species. The intensive agricultural activity and trade of these coastal regions - Andalucia, Murcia, Valencia and Catalonia - suggest that both agriculture and trade are the means of species introduction.

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Addresses of the authors:
Juan Pablo Del Monte & Pedro Luis Aguado, Unidad de Botánica Agrícola, E.T.S.I. Agrónomos, Av.da Complutense S/N 28040 Madrid, Spain.
(*)Email: jpmonte@pvb.etsia.upm.es

Appendix A

Catalogue of non-native plant species introduced in the Spanish Iberia in the period (1975-2002). N° indicates the reference number as registered on Appendix B.

PLANT SPECIES NAME	YEAR	Nº	SPANISH IBERIAN REGION (1)	ORIGIN	STATUS
Amaranthaceae					
Amaranthus blitum L. subsp. *emarginatus* (Moq. ex Uline & Bray) Carretero, Muñoz Garmendia & Pedro/	1979	1	15	Pantropical	Weed
Amaranthus blitum L. subsp. *polygonoides* (Zolling. ex Moq.) Carretero	1979	1	15	Pantropical	Weed
Amaranthus powelii S. Watson	1979	1	15	North America	Weed
Amaryllidaceae					
Narcissus calcicola Mendonça	1981	2	8	Portugal	
Apiaceae					
Apium leptophyllum (Pers.) F. Muell.	1985	3	15	South America	Weed
Bowlesia incana Ruíz & Pavón	1986	4	15	South America	Weed
Peucedanum schottii Besser ex DC.	1986	5	6	Europe	
Asclepiadaceae					
Asclepias syriaca L.	1982	6	4	North America	Weed
Asteraceae					
Achillea filipendulina Lam.	1982	7	10	East & Central Asia	Ornamental
Ageratina adenophora (Spreng.) King & H. Rob.*(=Eupatorium adenophorum* Sprengel*)*	1976	8	1	Central America	Weed & ornamental
Ambrosia coronopifolia Torr. & A.Gray	1976	9	6	North America	Weed
Ambrosia trifida L.	1982	10	7	America	Weed
Arctotheca calendula (L.) Levyns	1976	11	1	South Africa	Weed & ornamental
Artemisa tournefortiana Rchb.	1982	12	4	East & Central Asia	
Artemisia armeniaca Lam.	1994	13	2	East Europe	
Aster laevis L.	1986	14	6	North America	
Aster x versicolor Willd.	1976	15	6	North America	Ornamental
Bidens pilosa L.	1975	16	1	South & Cent.America	Weed
Centaurea depressa MB.	1984	17	15	Asia	Weed
Centaurea diffusa Lam.	1980	18	5	East Europe	Weed
Centaurea uliginosa (Brot.) Dostál	1979	19	1	Portugal	
Centipeda cunninghamii (DC.) A. Braun & Ascherson	1998	20	8	Australy/New Zealand	
Chrysanthemoides monilifera (L.) Norl.	1998	21	15	South Africa	
Conyza albida Willd. ex Sprengel	1981	22	1	South & Central America	Weed
Conyza primulaefolia (Lam.) Cuatre. & Lourteig (= *C. chilensis* Spreng.)	1980	23	15	South America	Weed
Cotula australis (Siever ex Spreng.) Hooker fil.	1976	24	6	Australy/New Zealand	Weed
Cotula mexicana (DC.) Cabrera	1997	25	10	South&Centr. America	Weed
Daveaua anthemoides Mariz	1981	26	1	Portugal	Ornamental
Erigeron karwinskianus DC.	1976	27	6	Central America	Weed & ornamental
Cont. Asteraceae					
Filago lutescens Jordan subsp. *Atlantica* Wagenitz	1981	28	1	Portugal	
Flaveria bidentis (L.) O. Kuntze	1990	29	11	South America	Weed
Gaillardia aristata Pursh	1981	30	1	North America	Ornamental
Gaillardia pulchella Fong.	1985	31	10	North America	Weed & ornamental
Gamochaeta filaginea (DC) Cabrera	1984	32	4	South America	Weed
Gamochaeta pensylvanica (Willd.) Cabrera	1980	33	1, 15	South & Central America	Weed
Gamochaeta spicata (Lam.) Cabrera	1979	34	9	North America	
Gamochaeta subfalcata (Cabrera) Cabrera *(= Gnaphalium subfalcatum* Cabrera*)*	1979	19	1	South America	
Guizotia abyssinica (L.fil) Cass.	1981	35	1, 6, 15	East Africa	Ornamental
Helianthus x laetiflorus Pers	1986	36	1	North America	
Onopordum dissectum Murb.	1979	19	1	North Africa	
Senecio inaequidens DC (=*S. harveianus* MacOwan*)*	1985	37	13	South Africa	Weed
Senecio pterophorus DC	2000	38	6	South Africa	

PLANT SPECIES NAME	YEAR	Nº	SPANISH IBERIAN REGION (1)	ORIGIN	STATUS
Soliva pterosperma (Juss.) Less	1985	37	13	South America	Weed
Verbesina encelioides (Cav.) Benth.&Hook.	1981	39	15	North America	Weed & ornamental
Wedelia glauca (Ortega) O. Hoffm. ex Hicken	1988	40	15	South America	Weed
Balsaminaceae					
Impatiens balfuorii Hook. F.	1976	15	6	Central Asia	Ornamental
Impatiens parviflora DC.	2003	41	4	Central Asia	Ornamental
Betulaceae					
Alnus viridis (Chaix) DC. subsp. *viridis*	1994	42	6	Central Europe	
Boraginaceae					
Amsinckia calicina (Moris) Chater	1986	43	4	South America	Weed
Amsinckia lycopsoides (Lehm) Lehm	1979	44	4	North America	Weed
Anchusa stylosa Bieb	1981	45	1	Mediterranean area	
Brassicaceae					
Diplotaxis tenuisiliqua Delile	1997	46	11	North Africa	Weed
Ionopsidium savianum (Caruel) Ball ex Arcang	1992	47	14	Europe	
Neotorularia torulosa (Desf.) Edge & Leónard	1992	48	11	Europe & Asia	
Rorippa curvisiliqua (Hook) Bessey ex Britton	2000	49	9	North America	
Clypeola cyclodontea Delile	1992	50	2	North Africa	
Cactaceae					
Opuntia humifusa (Rafin.) Rafin. Var. Humifusa	1986	51	9	America	Weed
Opuntia phaeacantha Englemann	1992	52	10	North&Cent.America	
Caryophyllaceae					
Arenaria marschlinsii Koch	1983	53	6	Europe	
Silene oropendiorum Cosson ex Batt.	1984	54	5	North Africa	
Chenopodiaceae					
Atriplex chenopodioides Batt	1984	55	1	North Africa	Weed
Atriplex semibaccata R. Br.	1987	56	11	Austral./New Zeal.	Weed & forage
Chenopodium pumilio R. Br.	1983	57	8	Austral./New Zeal.	Weed
Commelinaceae					
Tradescantia pallida (Rose) R.S.Hunt	1999	58	6	Central America	Ornamental
Zebrina pendula Schnizlein	1999	59	1	Central America	Ornamental
Convolvulaceae					
Convolvulus betonicifolius Miller	1981	59	1	East Europe	
Dichondra micrantha Urb.	1996	60	13, 7	East Asia	Weed & ornam.
Ipomoea stolonifera (Cyr.) J.F. Gmelin	1983	61	15	North America	Weed
Cuscutaceae					
Cuscuta campestris Yuncker	1979	62	15, 6, 12	North America	Parasite Weed
Cyperaceae					
Fimbristyllis hispidula (Vahl) Kunth var. *coiniana* (Savi) Boeck. *(=F. cioniana* Savi.*)*	1979	19	1	Mediterranean area & North Africa	
Kyllinga brevifolia Rottb.	1999	63	1	America & Asia	Weed
Rhynchospora rugosa (Vahl.) S. Gale	1979	19	1	Africa & Asia	
Elatinaceae					
Elatine brochonii Clavaud	1980	64	4	Europe & North Africa	
Euphorbiaceae					
Chamaecyse humifusa (Willd. ex Schlecht.) Prokh	1982	65	15	Asia	Weed
Chamaecyse humistrata (Gray) Small.	1992	66	1	North America	
Euphorbia chamaecyse L. subsp.*massiliensis* (DC) Thell	1980	67	1	Mediterranean area	Weed
Euphorbia marginata Pursh	1984	68	1	North America	Weed &

PLANT SPECIES NAME	YEAR	N°	SPANISH IBERIAN REGION (1)	ORIGIN	STATUS
Euphorbia welwitschii Boiss. & Reuter	1982	69	8	North Africa	ornamental
Fabaceae					
Lathyrus pisiformis L.	1977	70	5	Central, East Europe & Asia	Ornamental
Lupinus polyphyllus Lindley	1976	15	6	North America	Orn. & forage
Vicia altissima Des.	1977	70	1, 6	Mediterranean area	Ornamental
Vicia eriocarpa (Hausskn.) Halácsy	1979	19	1	Mediterranean area	
Gentianaceae					
Centaurium littorale (D. Turner) Gilmour subsp. *littorale*	1995	71	15	Europe	
Haloragaceae					
Myriophyllum heterophyllum Michx	1997	72	15	North America	Weed
Hyacinthaceae					
Hyacinthoides italica (L.) Rothm.	1989	73	9	Mediterranean area	
Hydrocharitaceae					
Egeria densa Planchon	1995	74	15	South America	Weed
Najas gracillima (A.Br. Ex Engl.) Magnus	1984	75	6	North America	
Hydrophyllaceae					
Phacelia tanacetifolia Bentham	1989	76	9	North America	Weed & crop
Iridaceae					
Hermodactylus tuberosus (L.) Miller	2000	77	8	Mediterranean area	
Sisyrinchium platense I.M. Johston	1991	78	6	South America	
Juncaceae					
Juncus acutiflorus Ehrh. ex Hoffmanns. subsp. *rugosum* (Steudel) P. Coutinho	1979	19	1	Portugal	
Juncus capillaceus Lam.	1987	79	9	South America	
Lamiaceae					
Lamium moluccellifolium Fries	1980	80	4	Europe	Weed
Salvia microphylla Kunth.	1986	81	1	Central America	
Liliaceae					
Allium schmitzii Coutinho	1980	44	4	Portugal	
Malvaceae					
Hibiscus palustris L.	1986	82	7	North America	Weed
Malvella leprosa (Ortega) Krapov	1995	83	15	America	
Sida spinosa L.	1987	84	6	America, Africa & Asia	Weed
Martyniaceae					
Proboscidea louisianica (Miil.) Thell	2000	85	10	North & Central America	Weed & ornamental
Nyctaginaceae					
Boerhavia repens L.	1995	86	15	North America	Weed & ornamental
Nymphaceae					
Nuphar pumila (Timm) DC.	1983	87	3	Europe	
Onagraceae					
Fuchsia magellanica Lam.	2000	88	13	South & Central America	Weed & ornamental
Ludwigia natans Elliot	1995	74	15	North America	Weed
Orchidaceae					
Epipactis phyllanthes G.E. Sm.	1985	89	7	Europe & Asia	
Orobancheaceae					
Orobanche laserpitii-sileris Reuter ex Jordan	1976	90	2	Europe	Weed
Phormiaceae					

PLANT SPECIES NAME	YEAR	N°	SPANISH IBERIAN REGION (1)	ORIGIN	STATUS
Phormium tenax J.R. Forst. & G. Frost.	2001	91	9	Australy/New Zealand	Ornamental
Poaceae					
Arundinaria japonica Siebold. & Zucc. ex Steudel	1985	14	6	East Asia	Ornamental
Axonopus affinis Chase	1983	92	15	South Africa	Weed
Brachiaria platiphylla (Griseb) Nash	1995	93	6	North America	Weed
Bromus commutatus Schrader subsp.*neglectus* (Parl.) P.M. Sm.	1986	36	1	Europe & North Africa	Weed & revegetation
Bromus inermis Leyss.	1983	92	15	Europe	Weed & revegetation
Cenchrus ciliaris L.	1981	94	15	Africa & Asia	Weed
Chloris gayana Kunth	1979	95	1	Africa	Weed & revegetation
Chloris virgata Swartz	2000	96	6	Central America	Weed & revegetation
Digitaria ciliaris (Retz.) Koeler	1986	36	1	Asia	Weed
Dinebra retroflexa (Vahl.) Panz	1983	92	15	Central Africa & Asia	Weed
Cont. Poaceae					
Ehrharta calycina Sm.	1982	97	1	South Africa	Revegetation
Eleusine tristachya (Lam.) Lam.	1979	98	6	Africa	Weed
Elymus elongatus (Host) Runemark subsp. *ponticum* (Poppd.) Melderis	1999	99	8	Europe	Revegetation
Eragostris neomexicana Vasey ex Dewey	1991	100	3	Central America	
Eragrostis bahiensis Schard. ex Schultes	1988	101	9	South America	Weed
Eragrostis curvula (Schrader) Nees	1985	102	10, 6	South Africa	Weed & revegetation
Eragrostis virescens C. Presl	1986	103	1	South America	Weed
Festuca quadriflora Honck.	1999	104	2	Europe	
Leptochloa fascicularis (Lam.) A. Gray *(Diplachne fascicularis* (Lam.) Beauv.*)*	1991	105	8	America	Weed
Leptochloa uninervia (C. Presl) A. Hitchc.&Chase	1991	106	6	America	Weed
Lophochloa hispida (Savi) V. Täckholm	1979	19	1	Mediterranean area	
Panicum antidotale L.	1986	107	6	America	
Panicum dichotomiflorum Michx.	1982	108	2	North America	Weed
Parapholis marginata Runemark	1984	109	15	Mediterranean area	
Paspalum saurae (Parodi) Parodi	1987	110	15	South America	Weed
Paspalum urvillei Steudel	1979	111	1	South America	Weed
Pennisetum setaceum (Forskal) Chiov	1990	112	15	West Asia & North Africa	Weed & revegetation
Phalaris stenoptera Hackel	1983	92	15	Europe & Asia	Weed & forage
Setara faberi Herrm	1986	113	9	Asia	Weed
Setaria geniculata (Lam.) Beauv	1981	114	8	North America	Weed
Setaria verticilliformis Dumort	1983	92	15	Mediterranean area	Weed
Spartina densiflora Brong	1979	19	1	South America	Revegetation
Stipa papposa Nees	1985	115	6	South America	Ornamental
Stipa trichotoma Nees	1991	116	6	South America	
Polygonaceae					
Muehlenbeckia complexa (A. Cunn.) Meissner	1990	117	7	Australy/New Zealand	Weed & ornamental
Polygonum orientale L	1975	16	1	East Asia	Weed & ornamental
Polygonum pensylvanicum L.	1998	118	15	North America	Weed
Reynoutria japonica Houtt	1976	119	6	East Asia	Weed & ornamental
Rumex cristatus DC	1987	120	5	Mediterranean area	
Rumex dentatus L. subsp.*halacsyi* (Rech.) Rech.fil.	1979	19	1	Mediterranean area	Weed

PLANT SPECIES NAME	YEAR	N°	SPANISH IBERIAN REGION (1)	ORIGIN	STATUS
Pontederiaceae					
Heteranthera limosa (Sw.) Willd.	1995	121	8	America	Weed
Heteranthera reniformis Ruiz & Pavón.	1993	122	2	America	Weed
Heteranthera rotundifolia (Kunth) Griseb	2001	123	2	America	Weed
Eichornia crassipes (C.F.P.Mart.) Solms.-Laub	1989	124	15	South America	Weed & ornamental
Primulaceae					
Androsace helvetica (L.) All.	1983	125	2	Central Europe	
Ranunculaceae					
Clematis glauca Willd.	1977	70	2	Central Asia	Ornamental
Rosaceae					
Rubus brigantinus Samp.	1997	126	5	Portugal	
Sapotaceae					
Argania spinosa (L.) Skeels	1987	127	15	North Africa	Crop
Saxifragaceae					
Saxifraga stolonifera Meerb.	1999	128	6	East Asia	Ornamental
Scrophulariaceae					
Antirrhinum lopesianum Rothm.	1989	129	4	Portugal	
Solanaceae					
Physalis philadelphica Lam.	1983	57	5	Central America	Weed & crop
Solanum bonariense L.	1981	130	15	South America	Weed
Cont. Solanaceae					
Solanum citrillifolium A. Braun	1997	131	1	Central America	
Solanum cornutum Lam.	1979	132	2	America	Weed
Solanum elaeagnifolium Cav.	1979	62	15	South America	Weed
Solanum laciniatum Aiton.	1989	76	9	Australy/New Zealand	Weed
Solanum nigrum L. subsp. *schultesii* (Opiz) Wessely	1979	133	4	Mediterranean area	Weed
Solanum physalifolium Rusby var. *nitidibaccatum* (Bitter) Edmonds	1984	134	10	South America	Weed
Solanum sarrachoides Sendt.	1984	135	5	South America	Weed
Solanum sisymbrifolium Lam.	1999	136	1	South America	Weed
Tetragoniaceae					
Tetragonia tetragonoides (Pallas) O. Kuntze	1985	37	13	Australy/New Zealand	Weed & ornamental
Thymelaeaceae					
Thymelaea gussonei Boreau	1987	137	1	Mediterranean area	
Valerianaceae					
Valerianella orientalis (Schlecht.) Boiss. & Bal.	1984	138	1	East Europe & West Asia	
Verbenaceae					
Verbena bonariensis L.	1985	89	7	South America	Weed

(1) Spanish Iberian Region 1. Andalucía; 2. Aragón; 3. Asturias; 4. Castilla-León; 5. Castilla- La Mancha; 6. Cataluña; 7. Cantabria; 8. Extremadura; 9. Galicia; 10. Madrid; 11. Murcia; 12. Navarra; 13. País Vasco; 14. Rioja; 15. Valencia.

Appendix B

Reference of non-native plant species; the number of each reference agrees with the number indicated on Appendix A.

1	Carretero, J. L. 1979: El género *Amaranthus* en España. - Collect. Bot. **11(4)**:105-142
2	Pérez Chiscano J. L. 1981: Primeras citas para España de *Narcissus calcicola* Mendonça. - Anales Jard. Bot. Madrid **38(1)**: 301-302
3	Carretero, J. L. 1985: Aportaciones a la flora exótica valenciana. - Collect. Bot. **16(1)**: 133-136
4	Carretero, J. L. 1986: *Bowlesia incana* Ruiz&Pavón en España. - Anales Jard. Bot. Madrid **43(1)**: 177
5	Molero, J. & Rovira, A. M. 1986: *Peucedanum schottii* Besser ex DC. Novedad para la flora ibérica. - Anales Jard. Bot. Madrid **42(2)**: 537
6	Navarro Andrés, F., Sánchez Rodríguez, J. A. & Valle, C. J. 1982: Observaciones sobre algunas plantas nuevas o poco conocidas en las floras salmantina y zamorana. - Studia Botanica **1**: 15-16
7	Ruiz de la Torre, J., Abajo, A., Carmona, E., Escribano, R., Ortega, C., Rodríguez, A. & Ruiz del Castillo, J. 1982: Aproximación al catálogo de plantas vasculares de la provincia de Madrid. - Comunidad de Madrid 135 pp.
8	Martín Calderón, G., Negrillo, A. M., Lopez, M. & Aroza, P. 1984: Algunas plantas interesantes que viven bajo los cultivos subtropicales de la provincia de Granada. - Anales Jard. Bot. Madrid **40(2)**: 470-471
9	Hansen, A. 1976: *Ambrosia* L. Flora Europaea, **4**: 143. - Cambridge
10	Laínz, M. & Loriente, E. 1983: Contribuciones al conocimiento de la flora montañesa, II. - Anales Jard. Bot. Madrid **39(2)**: 412
11	Webb, D. A. 1976: *Arctotheca* Wendl. Flora Europaea **4**: 208. - Cambridge
12	Navarro Andrés, F. & Sánchez Rodríguez, J. A. 1982: *Artemisa tournefortiana* Rchb. Neófito de la flora española. - Studia Botanica **1**: 27-31
13	Mateo Sanz, G., Fabregat Llueca, C. & López Udias, S. 1994: *Artemisia Armeniaca* Lam. (*Asteraceae*), Novedad para la Península Ibérica. - Anales Jard. Bot. Madrid **52(1)**: 118-119
14	Romo, A. M. 1986: Two new adventitious plants for the Iberian Peninsula: Arundinaria japonica and Aster laevis. - Collect. Bot. Barcelona **16(2)**: 427
15	Vigo J. 1976: Sobre algunas plantas aloctonas. - Collect. Bot. Barcelona **10**: 355, 359, 360
16	Sagredo, R. 1975: Contribución al conocimiento de la flora almeriense. - Anales Jard. Bot. Madrid **32(2)**: 309-321
17	Smythies, B. E. 1984: Flora of Spain and the Balearich islands, I. - Englera, **3(1)**:1-212
18	Peinado Lorca, M. & Esteve Chueca, F. 1980: *Centaurea diffusa* Lam. , nueva especie para la Península Ibérica. - Anal. Jard. Bot. **36**: 139-142
19	Castroviejo, S.,Valdés-Bermejo, E., Rivas-Martínez, S. & Costa, M. 1980: Novedades floristicas de Doñana. - Anales Jard. Bot. Madrid **36**: 203-244
20	Sánchez Rodríguez, J. A. 1998: *Centipeda Cunninghamii* (DC.) A. Braun & Ascherson (*Asteraceae*), una planta adventicia nueva para Europa. - Anales Jard. Bot. Madrid **56(1)**: 167
21	Cristóbal, J. C., Camuñas, E. & Crespo, M. B. 1998: *Chrysanthemoides monilifera* (L.) Norl. (Asteraceae) Alóctona prácticamente nueva para la Flora Ibérica. - Anales Jard. Bot. Madrid **56(2)**: 390-391

22	Danin, A. 1981: Coniza albida Willd. - Lagascalia **10(1)**: 121
23	Carretero, J. L. & Esteras, F. J. 1980: Sobre la presencia de *Conyza chilensis* Spreng. En España. - Anales Jard. Bot. **36**: 425-426
24	Barrau 1976 Collect. Bot. Barcelona **10**: 29-30 In: Valdés-Bermejo, E. 1981 *Cotula australis* (Siber Ex Sprengel) Hooker fil. En Pontevedra (España). - Anales Jard. Bot. Madrid **38(1)**: 316
25	Del Monte, J. P. & Aguado P.L. 1997: Sobre la presencia de *Cotula mexicana* (DC.) Cabrera en España. - Anales Jard. Bot. Madrid **55(2)**: 481-482
26	Talavera, S. 1981: *Daveaua anthemoides* Mariz. - Lagascalia **10(1)**: 127
27	Folch i Guillen, R. 1976: Notes floristiques III. Quelques espèces nouvelles ou intéressantes de la zone littorale de la Catalogne méridionale. - Collect. Bot. Barcelona **X(8)**: 189
28	Devesa, J. A. & Rivera, J. 1981: *Filago lutescens* Jordan subsp.atlantica Wagenitz. - Lagascalia **10(1)**: 122
29	Carretero, J. L. 1990: *Flaveria bidentis* (L.) *o.kuntze(=F. Contrayerba* (Cav.) Pers.) en la Península Ibérica. - Anales Jard. Bot. Madrid **47(1)**: 253
30	Gallego, M. J. 1981: *Gaillardia aristata* Pursh. - Lagascalia **10(1)**: 124
31	García Antón, M. & Génova Fúster, M. M. 1985: Aportaciones a la flora matritense. - Lazaroa **8**: 388
32	Giráldez Fernández, X. & Rico Hernández, E. 1984: *Gamochaeta filaginea* (DC.) Cabrera: nueva adventicia en España. - Anales Jard. Bot. Madrid **41(2)**: 460-461
33	Carretero, J. L. & Esteras, F. J. 1980: Sobre la presencia de *Gamochaeta pensylvanica* (Willd).Cabrera en España. - Anales Jard. Bot. **36**: 407
34	Castroviejo, S.& Valdés-Bermejo, E. 1979: *Gnaphalium purpureum* L. Nombre a excluir del catálogo peninsular. - Anales Jard. Bot. Madrid **36**: 419-420.
35	Gallego, M. J. 1981: *Guizotia abyssinica* (L.fil) Cass. - Lagascalia **10(1)**: 123
36	Pujadas Salvá, A. & Hernandez Bermejo, J. E. 1986: Contribución al conocimiento de la flora arvense y ruderal de la provincia de Cordoba. - Lagascalia **14(2):** 203.225
37	Aseginolaza Iparragirre, C., Gómez García. D., Lizaur Sukia, X., Montserrat Martí, G., Morante Serrano, G., Salaverria Monfort, M. R., Uribe-Echebarria, Díaz, P. & Alejandre Saez, J. 1985: Catálogo florístico de Alava, Vizcaya y Guipuzcoa. - Vitoria-Gasteiz. 118,787,794
38	Pino, J., Afan, I., Sans, X. & Gutiérrez, C. 2000: *Senecio pterophorus* DC., a new alien species in the european mainland. - Anales Jard. Bot. Madrid **58(1)**: 188
39	Bolós, O. & Sierra, E. 1981: *Verbesina encelioides* al Migjorn valencià. - Butll. Inst. Catalana Hist. Nat., Sec. Bot. **46:** 159
40	Carretero, J. L. 1988: *Wedelia glauca* (Ortega) O. Hoffm. Ex Hicken en España. - Anales Jard. Bot. Madrid **45(1):** 346-347
41	Sanz Elorza, M., Sobrino Vesperinas, E. & Dana Sánchez, E. 2003: *Impatiens parviflora* DC. (*Balsaminaceae*), alóctona nueva para la flora ibérica. - Anales Jard. Bot. Madrid **60(1):** 227-228
42	Benito Alonso, J. L., Montserrat Recorder, P., & Ferrández Palacio, J. V. 1995: Primera cita de *Alnus viridis* (Chaix) DC. *subsp. viridis* para la Flora Ibérica. - Anales Jard. Bot. Madrid **52(2):** 212-214
43	Giraldez, X. 1986: Contribución al conocimiento de la flora zamorana. - Studia Botanica **5:** 176

44	Rico Hernandez, E. 1980: Aportaciones ala flora salmantina. - Anales Jard. Bot. Madrid **36:** 245-255
45	Valdés, B. 1981: *Anchusa stylosa* Bieb. - Lagascalia **10(1):** 119-120
46	Coy Gómez, E., Hernández González, A., Sánchez Gómez, P. & Güemes Heras, J. 1997: *Diplotaxis tenuisiliqua*, Delile, una especie nueva para la Península Ibérica. - Anales Jard. Bot. Madrid **55(2):** 465
47	Morales Valverde, R. 1992: *Jonopsidium savianum* (Caruel) Ball ex Arcang. (Cruciferae), novedad para la Península Ibérica. - Anales Jard. Bot. Madrid **50(2):** 275-276
48	Robledo, A., Ríos, S. & Alcaraz, F. 1992: *Neotorularia torulosa* (Desf.) Edge & Leonard (*Cruciferae*) en la Península Ibérica. - Anales Jard. Bot. Madrid **50(1):** 143-144
49	Gómez-Vigide, F. & Martínez-Laborde, J. B. 2000: *Rorippa curisiliqua* (*Cruciferae*), nueva en Europa. - Anales Jard. Bot. Madrid. **58(1):** 186
50	Mateo Sanz, G., Aguilella Palasí, A. & Morales, R. 1992: *Clypeola cyclodontea* Delile, Novedad para la Península Ibérica. - Anales Jard. Bot. Madrid **49(2):** 315-317
51	Costa Tenorio, M. & Morla Juaristi, C. 1986: Sobre la presencia en la Península Ibérica de *Opuntia humifusa* (Rafin.) Rafin. var. *Humifusa*. - Anales Jard. Bot. Madrid. **42(2):** 533-535
52	Gavilán, R. & Molina, A. 1992: Sobre *Opuntia phaecantha* Engelmann en España. - Anales Jard. Bot. Madrid **50(1):** 118-119
53	Vigo, J. 1983: El poblament vegetal de la Vall de Ribes I. Generalitas Catàleg floristic. - Acta Bot. Barc. **35:** 165
54	Peris J.B.& Stubing, G. 1984: *Silene oropediorum*, una especie nueva para la flora europea. - Anales Jard. Bot. Madrid **41(2):** 453
55	Pastor Díaz J.E. 1984: *Atriplex chenopodioides* Batt., nuevo para la flora ibérica. - Anales Jard. Bot. Madrid. **41(2):** 451
56	Castroviejo, S. 1987: Notas sobre *Atriplex* L. Ibéricas. - Anales Jard. Bot. Madrid **43(2):** 474-476
57	Carretero, J. L. 1983: *Chenopodium pumilio* R. Br. y *Physalis philadelphica* Lam. en España. - Collect. Bot. Barcelona **14:** 211-213
58	Sobrino Vesperinas E. & Sanz Elorza M. 2000: Sobre la naturalización de *Trasdescantia* y *Zebrina* (Commelinaceae) en España. - Anales Jard. Bot. Madrid **57(2):** 426-427
59	Valdés, B. & Ruiz de Clavijo, E. 1981: *Convolvulus betonicifolius* Miller. - Lagascalia **10(1):** 118-119
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61	Peris, J. B., Stubing, G. & González, E. 1984: *Ipomoea stolonifera*, un neófito litoral - psamófilo nuevo para la flora ibérica. - Anales Jard. Bot. Madrid **40(2):** 467-468
62	Carretero, J. L. 1979: *Solanum elaeagnifolium* Cav. y *Cuscuta campestris* Yuncker, nuevas especies para la flora española. - Collect. Bot. **11:** 143-154
63	Sánchez Gullón, E. 1999: *Kyllinga brevifolia* (Cyperaceae), naturalizada en España. - Anales Jard. Bot. Madrid **57(1):** 176
64	Sánchez Sánchez, J. 1979: Notas florísticas para la provincia de Salamanca (España). - Anales Jard. Bot. Madrid **36:** 269-270
65	Costa, M., Peris, J. B. & Figuerola, R. 1982: Notas corológicas levantinas, II. - Lazaroa **4:**374

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67	Valdés, B. 1980: *Euphorbia chamaecyse* L. subsp. *massiliensis* (DC) Thell. In Ascherson & Graebner, Syn. Mitteleur. Fl.7:457(1917). - Lagascalia **9(2):** 245
68	Fernández López, C. & Aranda Haro, F. 1984: Notas para la flora de Jaén, II. - Blancoana **2:** 43
69	Ladero, M., Navarro, F., Perez Chiscano, J. L. & Valle, C. J. 1983: Novedades para la flora extremadurense y boreocircunextremadurense. - Studia Botanica **2:** 181-184
70	Valdés-Bermejo, E. & Lopez, G. 1977: Aportaciones a la Flora Española. - Anal. Inst. Bot. A. J. Cavanilles **34(1):** 157-173
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72	Cirujano, S. & Medina, L. 1997: *Myriophyllum heterophyllum* Michx. (*Haloragaceae*), naturalized in Spain. - Anales Jard. Bot. Madrid **55(1):** 164-165
73	Ortiz, S. & Rodríguez Oubiña, J. 1990: *Hyacinthoides italica* (L.) Rothm. en territorio español. - Anales Jard. Bot. Madrid **47(1):** 259
74	Cirujano, S., Medina, L., Stübing, G. & Peris, J. B. 1995: *Egeria densa* Planchon (*Hydrocharitaceae*), naturalized in Spain and *Ludwigia natans* Elliot (*Onagraceae*), a xenophyte new to european flora. - Anales Jard. Bot. Madrid **53(1):** 140-141
75	Farràs, A. 1984: *Najas gracillima* (A. Braun ex Engelm.) Magnus a Catalunya. - Butll. Inst. Catalana Hist. Nat., Sec. Bot. **51:** 178
76	Bujan, M., Romero, M. I., Cremades, J. & Amigo, J. 1989: Sobre flora alóctona del noroeste peninsular. - Anales Jard. Bot. Madrid **45(2)**: 570-571
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81	Valdés, B. 1986: In Greuter & Raus (ed.). Med-Checklist Notulae 12. - Willdenowia **15:** 422
82	Aedo, C., Herrá, C., Lainz, M., Loriente, E., Moreno Moral, G. & Patallo, J. 1986: Contribuciones al conocimiento de la flora montañesa, V. - Anales Jard. Bot. Madrid **43(1):** 61
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84	Mayoral i Arqué, A. 1987: *Sida spinosa* L. (*Malvaceae*) a la Península Ibèrica. - Collectanea Botanica **17(1):** 153
85	Martín Madrigal, E. & Fernández González, F. 2000: *Proboscidea louisianica* (Mill.)Thell. (*Martyniaceae*) en España. - Anales Jard. Bot. Madrid, **58(1):** 190-191
86	Soler, J. X. 1995: Primera cita de *Boerhavia repens* L. (*Nyctaginaceae*) para la flora ibérica. - Anales Jard. Bot. Madrid. **53(1):** 123-124
87	Fernández Bernaldo de Quiros, C. 1984: *Nuphar pumila* (Timm) DC., un nuevo nenúfar para la flora Ibérica. - Anales Jard. Bot. Madrid **40(2):** 465-466

88	Campos Prieto, J. A. & Herrera Gallastegui, M. 2000: Datos sobre flora vascular introducida en el País Vasco. - Anales Jard. Bot. Madrid **57(2):** 440
89	Aedo, C., Herrá, C., Laínz, M., Loriente, E., Moreno Moral, G. & Patallo, J. 1985: Contribuciones al conocimiento de la flora montañesa, IV. - Anales Jard. Bot. Madrid **42(1):** 197-213
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91	Vitek E. 2001: *Phormium tenax* (*Phormiaceae*), locally naturalised on the cantabrian coast (Spain). - Anales Jard. Bot. Madrid **58(2):** 363
92	Carretero, J. L. & Esteras, F. J. 1983: Algunas gramíneas de interés corológico para la provincia de Valencia. - Coll. Bot. **14:** 215-219
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94	Esteras, F. J. 1981: Las gramíneas en la provincia de Valencia. Contribución de la Taxonomía numérica a su clasificación. - Valencia Doctoral Thesis, **182**
95	Sagredo, R. 1979: *Chloris gayana* Kunth en Almería. - Anal. Jard. Bot. Madrid **36:** 419
96	Vallverdú Azón, J. 2000: *Chloris virgata* (*Gramineae*), alóctona nueva para la Península Ibérica. - Anales Jard. Bot. Madrid **57(2):** 429
97	Charpin, A. & Romero Zarco, C. 1982: Presencia de *Ehrharta calycina* Sm. En España. - Saussurea **13:** 187-188
98	Bolós, O. & de Vigo, J. 1979: Observacions sobre la flora del països catalans. - Collect. Bot. **11:** 25-89
99	Vázquez, F. M. 1999: *Elymus elongatus* subsp. *ponticum* (*Gramineae*) en la Península Ibérica. - Anales Jard. Bot. Madrid **57(1):** 176
100	Lastra Menéndez, J. J. & Mayor López, M. 1991: Fragmenta chorologica occidentalia, 3624-3629. - Anales Jard. Bot. Madrid **49(1):** 125
101	Renvoize, S. A. & Silva-Pando, F. J. 1988: *Eragrostis bahiensis*, in Valdés Bermejo, E. & al., Flora del Noroeste de la Península Ibérica. Exsiccata, III. - Lourizan (Pontevedra)
102	Nieto Feliner, G. 1985: *Eragrostis curvula* (Schrader) Nees: Una nueva gramínea para la Flora española. - Anales Jard. Bot. Madrid **42(1):** 255
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