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Introduction of species associated with crops: the case of genera *Amsinckia* and *Leptochloa* in Spain

Abstract

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The occurrence of *Amsinckia* Lehm. and *Leptochloa* Beauv. in Spain is studied following new records of *A. lycopsoides* and *L. uninervia* for Spain. Brief taxonomic considerations about the species found in Spain are discussed. Finally, their present distribution in Spain is reported.

Introduction

Man has been one of the most important agents of plant species dispersal because of his continuous contribution, whether accidental or deliberate, to plant transfer. An example of this is trade, that is leading to a certain degree of globalization. As a result, the natural distribution of many plant species -*e.g.* species used as agricultural crops- has been altered. Mack (1991) studied the effect of the postal seed trade on the flora of the USA. He proved that several species traded in the late 1800's and early 1900's have become weeds in USA and are now competing with several crops, resulting in a decrease in crop yields and in a lower quality of the crop produce. Moreover, those species have no present recognised use.

This paper refers to some allochthonous plant species recently introduced in Spain that have become aggressive competitors of crops (crop weeds) and consequently, seem now to be naturalized in our country. In particular, this work deals with two genera native to America: *Amsinckia* Lehm. (*Boraginaceae*) and *Leptochloa* Beauv. (*Poaceae*), whose introduction into Spain might well have occurred as a result of the seed trade. The presence of some species of these genera in Spain is now far beyond mere botanical record because they are becoming harmful weeds in some agricultural areas, to the point that herbicide control is essential.

The first records of *Amsinckia* and *Leptochloa* in Spain date back to 1977 (Rico, 1980) and 1988 (Peinado & al. 1990), respectively. However, the possible spread of species of these genera in Spain has not been reported yet; nor do any Flora report these genera as naturalized in Spain.

The aim of this work was: (i) to report two new records of *Amsinckia* and *Leptochloa*

in Spain, ii) to carry out a review of the presence of those genera in Spain and (iii) to outline the present distribution of the species reported for Spain.

Material and Methods

Plant material for this study came from two complementary sources of botanical information: botanical fieldwork and the examination of herbarium specimens. The plant search resulted in two new records of *Amsinckia* and *Leptochloa;* they were found in agricultural environments and behaved as aggressive weeds of specific crops. Consequently specimens of both genera were collected and deposited in the herbarium of the Department of Plant Production: Botany and Plant Protection, of the Polytechnic University of Madrid (Spain) (herbarium acronym, MAA). Then the species identification was carried out by an analysis of the morphological characteristics and the subsequent bibliographical search. The latter led to the examination of herbarium specimens included within these genera already deposited in the Botanical Garden of Madrid (Spain) (MA).

Results and Discussion

***Amsinckia* Lehm.** – As a result of the botanical exploration, we report a new record of the species *Amsinckia lycopsoides* (Lehm.) Lehm. for Spain. This species was found as a significant weed in cereal lands of the province of Segovia, in the municipality of Navalmanzano (30TUL9463). The area is located in the North Iberian Plateau and its climate is Continental-Mediterranean. The species is believed to have been first noticed about 7-8 years ago, according to the reports of several farmers.

According to García Rollán (1996) the presence of the genus *Amsinckia* in Spain is restricted to *A. lycopsoides* in the province of Salamanca (North Iberian Plateau). This statement is probably due to the fact that the first and only record of that species in Spain was reported there (Rico, 1980). However, there are records of other species in the genus for Spain. Giraldez (1986) was the first in Spain to report the presence of *A. calycina* (Moris) Chater (= *A. angustifolia* Lehm.). He found that species in 1983 in a restricted area of the province of Zamora (30TTL7192) (North Iberian Plateau). Some years later, Navarro and García (1992) found that species in another location in the same province (30TUM0401); on that occasion as a weed of cereal crops growing in sandy-clay soils. Another record of this species was given by Castroviejo & al. to the herbarium of the Botanical Garden of Madrid (Spain) (MA-488861). These authors located the same species in the municipality of Hoyos del Espino, in the province of Avila (North Iberian Plateau). In addition to these reports, the species has recently been found by the authors (May 2001) in Arganda (Madrid, Central Spain) (30TVK 5863).

From the aforementioned records, it may be inferred that two allochthonous species of *Amsinckia* have been introduced in a relatively small area of the North Iberian Plateau in a rather short period of time. This would mean that a multiple introduction might have taken place. On the other hand, as the distribution area is small, the possibility of there being only one species that is spreading in the area –and so, the possibility of some erroneous identification- should also be considered. The fact that the taxonomy of *Amsinckia*

is not easy might support such a hypothesis, because in the words of Chater (1972) '*the identity of the plants found in Europe is in some cases uncertain*". Moreover, inter-species hybridisation is a possibility that has been reported (Ganders in Hickman, 1993).

The general appearance of the species found in Spain, *A. lycopsoides* and *A. calycina,* is quite similar. The key botanical characteristics are the presence of hairs in the corolla-tube (Chater, 1972) and the position of the stamens (Stace, 1991). *A. lycopsoides* has a hairy corolla-tube and stamens inserted approx. half-way up the corolla-tube or below, whereas *A. calycina* has a glabrous corolla-tube with stamens borne on the upper half of the tube (see Figure 1). Both species have included stamens and style. Apart from *A. calycina,* there are also other species in the genus with a glabrous corolla-tube: *A. menziesii* (Lehm.) A. Nelson & Macbride and *A. intermedia* Fischer & C.A. Meyer, but they can be differentiated because their stamens insert in the area close to the corolla-throat and the styles extrude from the tube.

The *Amsinckia* herbarium specimens collected in Spain and deposited in the Botanical Garden of Madrid (MA) were re-examined for this work. As a result, the identification recorded by the collectors was verified. Consequently, it is confirmed that both *A. lycopsoides* and *A. calycina* are present in Spain. It can be stated therefore that a multiple introduction of *Amsinckia* has ocurred in Spain.

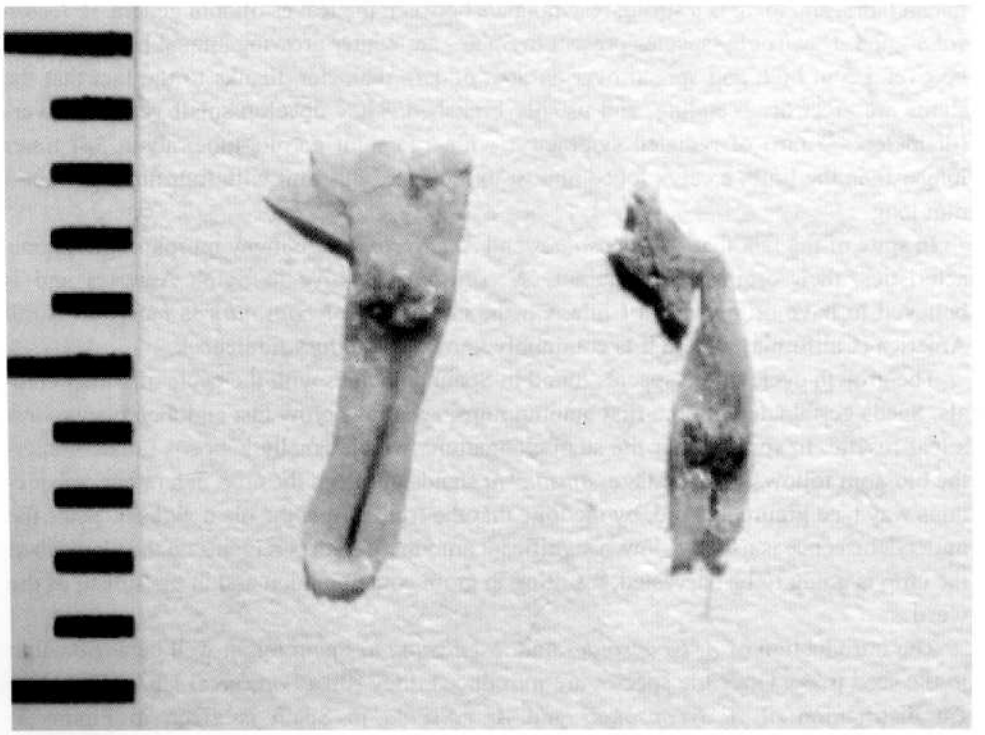

Fig. 1. *Amsinckia lycopsoides* (Lehm.) Lehm. (right) versus *Amsinckia calycina* (Moris) Chater (left): Stamens insertion.

Interestingly, the fact that *Amsinckia* is spreading in Spain is consistent with the progressive spread of the genus in France. Coste (1937) catalogued *A. calycina* (=*A. angustifolia* Lehm.; = *A. hispida* (Ruiz et Pavón) I.M.Johnston) within the Flora of France and mentioned that the first record of that species in France –under the synonym *A. angustifolia*- dated back to 1845. More recently, Guinochet and Vilmorin (1975) stated that both *A. calycina* and *A. lycopsoides* were present in France. They reported that these species were casuals and mentioned that the former could be found in the N, E, W and C of France and the latter in the N, NE and E of France. Fournier (1977) included two more species in the catalogue of the genus in France: *A. intermedia* Fischer & C.A. Meyer and *A. menziesii* (Lehm.) A. Nelson & Macbride, but remarked that *A. lycopsoides* was the most frequent species.

As regards other European countries, Polunin (1982) and Charter (1972) report that *Amsinckia* is a frequent casual in N, C, W and NW Europe. *A. lycopsoides* and *A. calycina* reached the British Isles (*A. lycopsoides* has been present there since 1922) and are now naturalized. Finally, as far as we could ascertain from searches, there are no records of *Amsinckia* in Italy or Portugal.

At the vegetative stage (*i. e.* without flowers), *Amsinckia* might be taken for *Echium*, and as a matter of fact it was in the past identified as *Echium* (and also within the genera *Heliotropium* and *Lithospermum*). Like *Echium*, its vegetative organs are covered with patent hairs, and there is a strong resemblance between the leaves of both genera. *A. lycopsoides* and *A. calycina* -species present in Spain- are winter growing annual herbs that can be over 1.5 m high and spread over an area of 1 m diameter, thanks to the fact that the stems are erect or ascending, and usually branched. They develop small yellow flowers (diameter <3 mm) of radiated symmetry; with a straight corolla-tube, about 3-4 times longer than the limb; a calyx lobed almost to the base, and fruit with four nutlets about 3 mm long.

In spite of the fact that *A. lycopsoides* and *A. calycina* share many morphological characteristics, their origins are different. *A. calycina* is native to South America and is believed to have originated in Chile. On the contrary, *A. lycopsoides* is native to North America (California), where it is commonly known as bugloss fiddleneck.

The growth cycle of the species found in Spain coincides with the cycle of winter cereals. Seeds germinate with the first autumn rains, seedlings grow fast and then plants form a leaf rosette. In spring, after the stem elongation –which usually happens in late winter- the blossom follows. In this stage, *Amsinckia* stands out from the crop in a rather conspicuous way (see Figure 2). And, by the time that the fruit is ripe, the plant withers. Since the nutlet dehiscence is usually slow, a significant amount of nutlets remains on the plant when the crop is going to be harvested, resulting in grain contamination and in the spread of the weed.

The introduction of *A. lycopsoides* and *A. calycina* to Spain might well be attributable to the seed trade. Once the species are introduced, they spread on cereal lands. The present distribution of *A. lycopsoides* and *A. calycina* in Spain is given in Figure 3. Accordingly, there is evidence that these species are now naturalised in the North Iberian Plateau.

Fig. 2. *Amsinckia lycopsoides* (Lehm.) Lehm. growing as an aggressive barley crop weed in Spain.

Fig. 3. Present distribution of *Amsinckia lycopsoides* (Lehm.) Lehm. (◊) and *Amsinckia calycina* (Moris) Chater (♦) in Spain.

***Leptochloa* Beauv.** – A new record of the species *Leptochloa uninervia* (C. Presl) A. Hitchc. & Chase is reported for Spain. *L. uninervia* has been found as a significant rice crop weed in the province of Seville (right bank of the Guadalquivir river) (30TQB4604; 30TQB5103; 30TQB5113; 30TQB5210; 30TQB5302; 30TQB5523; 30TQB5610; 30TQB5810; 30TQB5925). The same species was also found in other rice lands in the region of 'La Serena' (Badajoz province). The climate in those areas is rather warm and meets the requirements of the rice crop. It is usually described as mild-Mediterranean. *L. uninervia* competes strongly with rice crop in the aforementioned areas and sometimes causes large yield losses. As a result of this, the plant is becoming a well-known weed, to the point that it has got a local name in Seville: 'cola americana' (*i.e.* "American tail"), which makes reference to its origin.

There has been a certain controversy over the nomenclature and taxonomy of *L. uninervia* (C. Presl) A. Hitchc. & Chase. Some authors refer to this species as *Diplachne uninervia* (C. Presl) Parodi whereas others assign the subspecies rank to it and name it as *Leptochloa fusca* subsp. *uninervia* (C. Presl) N. Snow. At present, there seems to be a general agreement about the genus, which is recognised as *Leptochloa* after Brummitt (1992), Hickman (1993) and Snow (1998). In this work, we use the conservative name *L. uninervia* (C. Presl) A. Hitchc. & Chase.

Leptochloa consists of about 40 species that haave their origin in areas with subtropical climates. The occurrence of the genus in Europe is probably not confirmed by any European Flora except for the Spanish Flora of Extremadura (SW Spain) of Devesa (1991), which includes *Diplachne fascicularis* (Lam.) Beauv. (= *L. fascicularis* (Lam.) A. Gray). That record has been verified for this work by means of the examination of the specimens that are deposited in the Herbarium of the Botanical Garden of Madrid (Spain) (MA-522210 and MA-522211). On the presence of *D. fascicularis* in Extremadura, the author stated that the species '*is casual in Extremadura ... always found in restricted locations but densely populated*'.

The circumstances that surround the presence of *Leptochloa* in Spain are somewhat similar to those of *Amsinckia*. They share in common that they are allochthonous and have been recently introduced to Spain. Moreover, in both cases two species per genus (*A. lycopsoides* and *A. calycina*; *L. uninervia* and *L. fascicularis*) are reported and the species of a same genus are distributed in close locations close to each other: *Amsinckia* in different places in the North Iberian Plateau, and *Leptochloa* in Seville and Badajoz, that are bordering provinces in Southern Spain.

The bibliographic search carried out showed that there are several records of *L. uninervia* and *L. fascicularis* in different locations in Spain; in spite of that, the genus has not been included in any Spanish Flora except for the aforementioned Flora of Extremadura. Aparently, the introduction of the genus in Spain has ocurred several times but the spread of the introduced species was not always successful.

There are records of *L. uninervia* for N Spain as well as for S Spain. The first record dates back to 1985 (Mayoral, 1985) when the species was identified in Lleida (N Spain) as a summer weed of maize, and of orchards and meadows. However, it seems to have been ephemeral since there is no evidence for its presence nowadays. For S Spain, it was first reported by Peinado & al. in 1988, who found *L. uninervia* in Lora del Río (Seville) and Palma del Río (Córdoba).

As regards *L. fascicularis,* there are also records of its presence in very distant places within Spain. Rodríguez and Arias (1991) reported the presence of *Diplachne fusca* (L.) Beauv. in the province of Badajoz (in the areas of Zurbarán and Villanueva de la Serena) in a preliminary identification, but, as a result of a further identification, the record was changed to *Leptochloa fascicularis* (Rodríguez & al., 1991). This latter record is consistent with the records of Devesa (1991; 1993). At present, it has been confirmed that *L. fascicularis* is present in Badajoz (SW Spain). As regards East Spain, there is a record of *L. fascicularis* dated in 1993 for a restricted area of Sueca (Valencia province) -as a rice crop weed- but its presence was only ephemeral (Anonymous, 1995).

There is a close resemblance between *L. uninervia* and *L. fascicularis,* as regards their appearance and morphological features. Both species are annual herbs about 1 m high, are native to California (USA), with late spring/summer growth, and usually grow in wetlands. The vernacular name of *Leptochloa* in USA is sprangletop. *L. uninervia* is usually known as Mexican sprangletop whereas *L. fascicularis* is known as bearded sprangletop, in a clear reference to the awned spikelets. In fact, the key visual characteristics for distinguishing between *L. uninervia* and *L. fascicularis* are the lemma apex shape and the absence or presence of awn. The lemma of the former is obtuse to truncate, mucronate and awnless whereas the latter exhibits acute lemma with an awn of 0.5-3 (5) mm long (see Figure 4). Apart from these features, there are some minor characteristics that may help to identify them, such as the panicle colour and compactness; *L. uninervia* usually develops darker and more compact panicles than *L. fascicularis*. Snow (1998) revised the genus *Leptochloa* and as a result of cladistic studies proposed the reduction in rank of *L. uninervia* and *L. fascicularis* to subspecies: *L. fusca* (L.) Kunth subsp. *uninervia* (C. Presl) N. Snow and *L. fusca* (L.) Kunth subsp. *fascicularis* (Lam.) N. Snow, respectively.

Specimens of *Leptochloa* collected from rice fields in Seville (right bank of the Guadalquivir river) and Badajoz (La Serena region) in 1999 and 2000 –presently deposited in the herbarium of the Department of Plant Production: Botany and Plant Protection of the Polytechnic University of Madrid (MAA)- were examined for a further species identification. As a result, it is confirmed that *L. uninervia* is present in both areas whereas *L. fascicularis* is only present in Badajoz.

Figure 5 shows the lemma of the 1st, 3rd, 5th, 7th and 9th florets of a spikelet of *L. uninervia* picked up from specimens of Seville and of Badajoz. In spite of the fact that there is a certain gradation of the lemma shape with the floret position, the general trend is that, whatever the origin of the specimen, the lemma apex of *L. uninervia* is always obtuse, mucronate (mucro < 0.5 mm long) and unawned, features that differenciate it from *L. fascicularis*.

The distribution of *L. uninervia* and *L. fascicularis* in Spain is shown in Figure 6. There is no evidence that these species are present in Catalonia (NE Spain) and Valencia (E Spain). *L. uninervia* is present in rice fields in Badajoz (Extremadura, SW Spain) and Seville (Andalucía, S Spain) whereas *L. fascicularis* is presently restricted to rice lands in Badajoz. It may be inferred from the data of this work that these species are becoming naturalized in these areas and that the presence of both species in Spain is associated with the rice crop. It might well be the case that they were introduced by means of the rice seed trade.

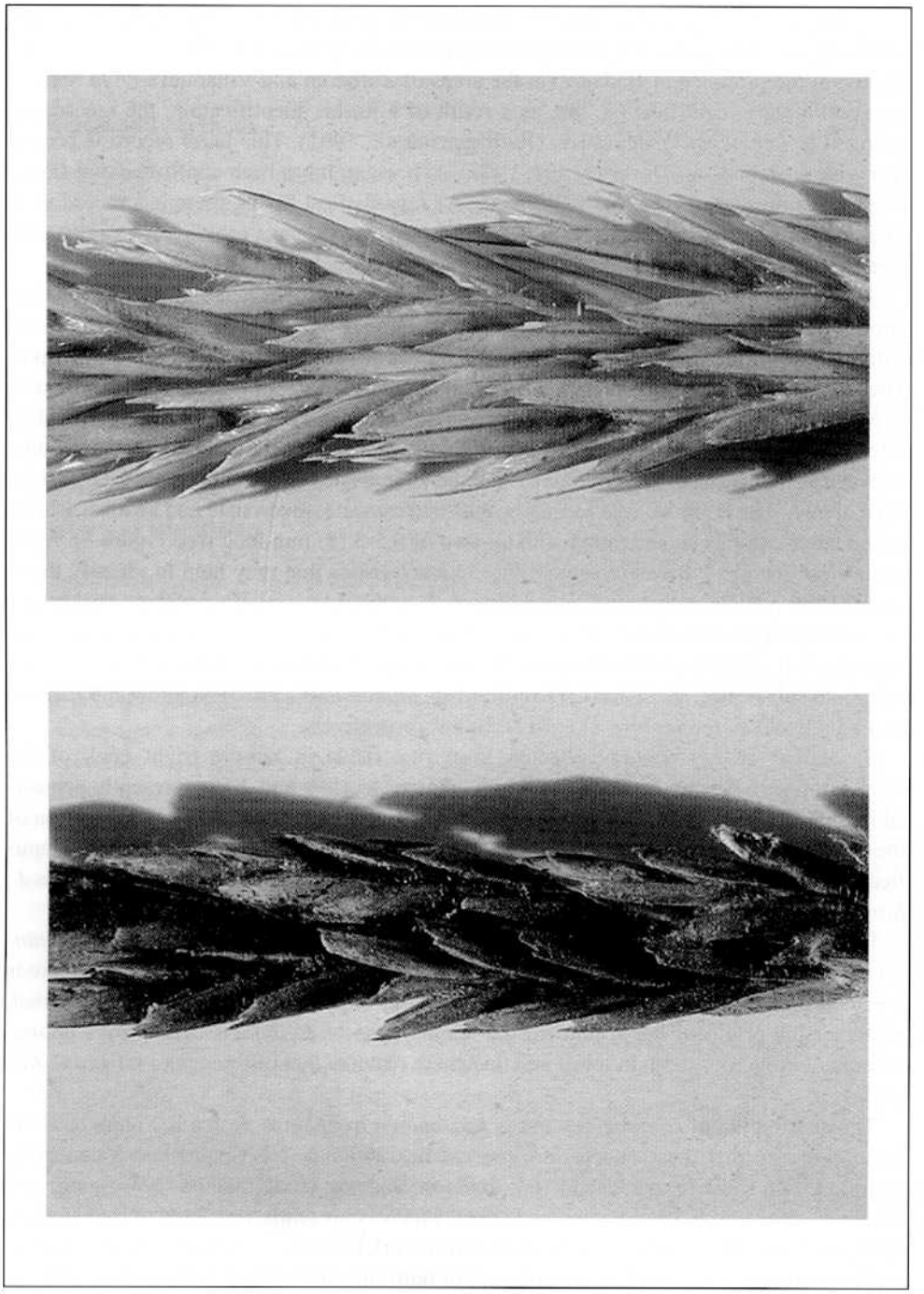

Fig. 4. *Leptochloa uninervia* (C. Presl) A. Hitchc. & Chase (left) versus *Leptochloa fascicularis* (Lam.) A. Gray (right): detail of the spikes.

Fig. 5. Florets of a spikelet of *Leptochloa uninervia* (C. Presl) A. Hitchc. & Chase.

Fig. 6. Present distribution of *Leptochloa uninervia* (C. Presl) A. Hitchc. & Chase (•) and *Leptochloa fascicularis* (Lam.) A. Gray (o) in Spain.

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References

Anonymous, 1995: Identificación de Malas Hierbas en el Cultivo del Arroz. — DUPONT Ibérica S.A.

Brummitt, R. K. 1992: Vascular Plant Families and Genera. — Royal Botanic Gardens, Kew.

Coste, H. 1937: *Amsinckia*. — Pp. 607 in: Flore descriptive et illustrée de la France, de la Corse et des contrées limitrophes II. — Librairie des Sciences et des arts. París.

Chater, A. O. 1972: *Amsinckia*. — Pp. 110 in: Tutin, T.G & al. (eds.), *Flora Europaea* **3** — Cambridge .

Devesa, J.A. 1991: Pp. 260-262 in: Las gramíneas de Extremadura. Devesa, J.A. (Ed.). Monografías Botánicas. — Universidad de Extremadura. Edit. Universitas, Badajoz.

Devesa, J.A. 1995: *Diplachne* Beauv. — Pp. 618 in: Flora y Vegetación de Extremadura. — Universitas Editorial. Badajoz.

Fournier, P. 1961: *Amsinckia*. — Pp. 734-735 in: Les Quatre Flores de la France. — Editions Lechevalier S.A.R.L. París.

Fournier, P. 1977: *Amsinckia*. — Pp. 734-735 in: Les Quatre Flores de la France. — Editions Lechevalier S.A.R.L. Paris.

Ganders, F.R. 1993: *Amsinckia*. — Pp. 367-369 in: Hickman, J.C. (Ed), The Jepson Manual. Higher Plants of California. — University of California Press. California.

García Rollán, M. 1996: *Amsinckia*. — Pp. 101 in: Atlas Clasificatorio de la Flora de España Peninsular y Balear. — Ed. M.A.P.A. y Ediciones Mundi-Prensa. Madrid. **1.**

Giraldez, X. 1986: Aportaciones al conocimiento de la Flora Zamorana. — *Studia Botanica* **5**:175-178.

Guinochet, M.; Vilmorin, R. 1975: *Amsinckia*. — Pp. 596 in: Flore de France. **2**. — Editions du Centre National de la Recherche Scientifique. París.

Mack, R. N. 1991: The commercial Seed Trade: An Early Disperser of Weeds in the United States. — Economic Botany **45(2)**:257-273.

McNeill, J. 1979: *Diplachne* and *Leptochloa* (*Poaceae*) in North America. — Brittonia **31**:399-404.

Mayoral, 1995: Pp. 59-65 in: Recasens y Conesa, Actas Congreso 1995 de la Sociedad Española de Malherbología. — Huesca.

Navarro Andrés, F., García Río, R. 1992: *Fragmenta Chorologica Occidentalia*, 4190-4228. — Anales Jard. Bot. Madrid, **50(1)**:100-103.

Peinado, M., Martinez Parras, J. M., Bartolomé, C., Álvarez, J., de la Cruz, M. 1990: Nuevas plantas y nuevas áreas para la Flora de Andalucía Occidental. — Lagascalia **16**(1): 125-129

Polunin, O. 1982: *Amsinckia*. — Pp. 384 in: Guía de Campo de las Flores de Europa. — Ed. Omega. Barcelona.

Recasens, J., Conesa, J. A. 1995: Nuevas malas hierbas alóctonas en los cultivos de regadío de Cataluña. — Actas Congreso 1995 de la Sociedad Española de Malherbología. Huesca, Pp. 59-65.

Rico Hernández, E. 1980: Aportaciones a la Flora Salmantina. — An. Jard. Bot. Madrid. **36**:245-255.

Rodriguez Bernabé , J. A., Arias Giralda, A. 1991: Presencia de una nueva mala hierba en los arrozales extremeños. — Pp. 120-123 in: Consejería de Agricultura y Alimentación de La Rioja (ed.), X Reunión del Grupo de Trabajo de Malas Hierbas y Herbicidas. Logroño.

Rodriguez Bernabé, J. A., Arias Giralda, A., Sanchez García, M., Jimenez Viñuelas, F. J. 1991: Ensayos de herbicidas para control de *Diplachne fascicularis* (Lam) Beauv. en arroz en siem-

bra directa. — Pp. 238-245 in: Actas Reunión 1991 de la Sociedad Española de Malherbología. Cordoba.

Saavedra, M., Cortés, J. A., Gómez de Barreda, D., Rodríguez Bernabé, J. A., Taberner, A., Castejón, M., Monserrat, A., Zaragoza, C. 1995: Malas hierbas de difícil control. — Ministerio de Agricultura Pesca y Alimentación. Madrid.

Snow, N. 1998: Nomenclatural changes in *Leptochloa* P. Beauvois *sensu lato* (*Poaceae, Chloridoideae*).— Novon: A Journal for Botanical Nomenclature **8(1)**: 77-80.

Stace, C. 1991: New Flora of the British Isles 651-652. — Cambridge.

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