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Data on germination rates and germinative vigour in *Artemisia (Asteraceae)*

Abstract

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Data on germinative ability and speed of germination in 13 European and 3 S.W. Asian (Armenian) populations of 10 taxa of *Artemisia* are presented. Germination rates are generally high, the germinative period is short and cypselas maintain their germinative power for a long period of time.

Introduction

We present new data on the germination rates of cypselas from 16 populations representing 10 different taxa belonging to 3 sections of *Artemisia* L. The assays were made as a corollary to root tip meristem production for a karyological study (Oliva 1990; Oliva & Vallès 1994).

Many *Artemisia* species are in use as food, medicinal and pastoral plants. It is of interest to determine their germination ability in view of their possible cultivation. Several authors have therefore contributed to this subject, e.g. Ouyahya (1980, 1983, 1987) on Moroccan species (5 of which are endemic); Payne (1957), McDonough & Harniss (1974), Evans & Young (1986), Young & Evans (1989) and Young & Young (1992) on N. American species; Ayerbe & Ceresuela (1982) on Macaronesian endemics; Vallès (1989) on Ibero-Balearic taxa; and Magherini & Nin (1990) on medicinal species obtained from agricultural seed producers.

Material

We list below the populations studied, grouped by sections. Vouchers are deposited in the herbarium of the Laboratory of Botany, Faculty of Pharmacy, University of Barcelona (BCF). Country abbreviations follow Tutin & al. (1993).

Artemisia sect. *Artemisia*

A. chamaemelifolia Vill. – **Hs,** Andorra: Canillo, towards Vall de Riu, schists, 1600 m, UTM 31TCH81, 24 Jan. 1988, *Peñuelas & Vallès* (BCF 34758).

A. vulgaris L. – Armenia, 1989, *Gabrielian* (BCF).

– **Hs,** Catalonia: Ripollès, Queralbs, ruderal place in the village, UTM 31DG38, 12 Oct. 1988, *Oliva, Simon & Vallès* (BCF 35556).

– **Rs,** Leningradskaja Oblast: Petrodvorec, slopes on the shores of the Baltic Sea. 24 Mar. 1988, *Vallès* (BCF 35060).

A. tournefortiana Rchb. – **Hs,** Madrid: Titulcia, banks of River Jarama, ruderal, UTM 30TVK54, 10 Nov. 1985, *Vallès* (BCF 32967).

– Armenia, Talin, 1500 m, ruderal places, 26 Aug. 1995, *Fajvuš & al.* (BCF 41935).

A. annua L. – **Ga,** Languedoc-Roussillon, Hérault: Montpellier, La Pompignane district, spontaneous in a garden, UTM 31TEJ72, 20 Sep. 1988, *Mathez* (BCF 35559.)

– Armenia, Erevan, ruderal places in the city, 28 Aug. 1995, *Gabrielian & al.* (BCF 41934).

Artemisia sect. *Absinthium* DC.

A. umbelliformis Lam. subsp. *umbelliformis* – **Hs,** Catalonia, Ripollès: Pic de Noucreus, summit, siliceous rocks, 2700 m, UTM 31TDG29, 12 Oct. 1988, *Oliva, Simon & Vallès* (BCF 35054).

– – **Hs,** Catalonia, Ripollès: Coll de Noufonts, summit, siliceous rocks, 2700 m, UTM 31TDG29. 12 Oct. 1988, *Oliva, Simon & Vallès* (BCF 35059).

– subsp. *eriantha* (Ten.) Vallès & Oliva – **Hs,** Aragon, Huesca: Panticosa, between Collado del Infierno and Picos del Infierno, siliceous rocks, 2800 m, UTM 30TYN24, 27 July 1989, *Vallès & Villar* (BCF 35558).

– – **Hs,** Aragón, Huesca: Panticosa, near Pondiellos lakes, siliceous rocks, 2400 m, UTM 30TYN23, 27 July 1989, *Vallès & Villar* (BCF 35557).

– – **Gr,** Larisa: mount Olympus, SW of summit Skolio, 2700 m, 19 Sep. 1989, *Bayer & López* (MA).

A. assoana Willk. – **Hs,** Castilla, Soria: near Torralba del Burgo, *Juniperus thurifera* woodlands, UTM 30TWM00, 30 July 1988, *Vallès* (BCF 34759).

Artemisia sect. *Dracunculus* Bess.

A. campestris L. – **Hs,** Catalonia, Alt Empordà: Vilafant, verges of the road Figueres-Olot, UTM 31TDG97, 2 Jan. 1990, *Vallès* (BCF 35226).

A. crithmifolia L. – **Lu,** Douro Litoral: Vila do Conde, littoral sands, UTM 29TNF28, 27 July 1988, *Vallès* (BCF 35056).

Table 1. Germination parameters of the populations of *Artemisia* studied: number of charges, temperature at germination, number of cypselas sown and germinated, percentage of germinated and contaminated cypselas, germinative vigour in days.

Artemisia	pop.	charges (n)	temp. (°C)	cyps. (n)	germ. (n)	germ. (%)	contam. (%)	germ. vig. (d)
chamaemelifolia	Canillo	14	19-25	432	355	82.2	9	6.5
vulgaris	Armenia	4	19-23	60	18	30	33.3	13.5
vulgaris	Queralbs	1	19	20	17	85	0	7.5
vulgaris	Petrodvorec	12	19-25	350	335	95.7	3.5	3.5
tournefortiana	Titulcia	7	19-25	233	141	60.5	20	15.5
tournefortiana	Talin	3	22	150	147	98	0	7
annua	Montpellier	2	19	40	21	52.5	20	4.5
annua	Yerevan	2	22	140	44	31.4	0	12
umbelliformis subsp. *umbelliformis*	Pic de Nou Creus	18	19-25	526	523	99.4	0	5.5
umbelliformis subsp. *umbelliformis*	Coll de Nou Fonts	20	19-25	510	506	99.2	0.6	5.5
umbelliformis subsp. *eriantha*	Collado del Infierno	4	19-23	67	40	59.7	36.7	5
umbelliformis subsp. *eriantha*	Lagos de Pondiellos	1	19	15	6	40	60	5.5
umbelliformis subsp. *eriantha*	Mt Olympus	5	19-23	75	66	88	1.3	5
assoana	Torralba	21	19-25	593	566	95.5	1.7	4.5
campestris	Vilafant	3	19	80	44	55	26	5
crithmifolia	Vila do Conde	3	19-20	50	36	72	2.2	13.5
Total numbers or mean values:		117	n.a.	3341	2865	85.8	13.4	7.5

Method

Fruits (cypselas) obtained from wild material were placed on moist filter paper in a Petri dish and kept in the dark at room temperature, as done by Ouyahya (1983) for species of the same genus. Preliminary tests at 15° C, made on the high-mountain taxa *(A. umbelliformis),* had poor success, and these data were therefore eliminated from our results. All data reported here relate to germination tests carried out at temperatures between 19 and 25°C. No antifungal agents, which might affect germination power, were used. To ensure sterile working conditions, we always used boiled distilled water and we made all manipulations close to the open flame of an alcohol lamp and with alcohol cleaned implements.

The dishes were controlled daily after sowing, to restore optimal humidity conditions and note the number of germinated cypselas. We considered those cypselas as germinated in which the radicle or, in some abnormal cases, the cotyledons were visible with the naked eye. The daily controls lasted for one month in every test, after which time all cypselas that were able to germinate had done so. In addition to the germinated cypselas, we counted those which were contaminated so as to differentiate between cypselas with a

primary lack of germination power and those which had lost it, at least in part, due to subsequent fungal contamination.

A total number of 3341 cypselas were assayed. When less than 100 were available for one population, we used 15 achenes per Petri dish in every first test – or in one case, all 20 that were available at once (cf. Table 1). When we had more than 100 cypselas to test, the first charge was 30 per Petri dish. This was repeated in every case until the total number of cypselas was used. From collection to sowing, the achenes were stored at 15° C and 58% air humidity.

Results

Data obtained for every population by the germination tests – cypsela numbers, germination and contamination rates – are given in Table 1. The contamination was probably caused by fungal spores carried by the cypselas themselves, because contamination during manipulation was carefully avoided.

The lowest germination rate was 30 %, the highest was 99.4 % and the mean of all populations studied was 85.8 %. In 13 of the 16 populations considered, the germination rate exceeded 50 %.

Germination of viable cypselas generally occurs within 20 days from sowing. Regarding the speed, we can notice (Table 1) that in some taxa 50 % of the germinating total germinates within a few (3-5) days whereas in others the process takes more time (7-17 days).

Discussion

The generally high germination rates we found, with neither chemical nor physical pretreatment, entitles to the conclusion that germinative ability in the genus *Artemisia* is high. In this respect, our results agree with those of previous authors: Ouyahya (1980, 1983, 1987), who found germination rates ranging from 36 % to 90 %, having sterilized the cypselas with alcohol or calcium hypochlorite; Ayerbe & Ceresuela (1982; 100 %, without pre-treatment); Vallès (1989; 16-100 %, after sterilization of the cypselas with hydrargyrum bichloride); Magherini & Nin (48.5-91.6 %, without pre-treatment); Young & Young (1992; at least 80 %, without pre-treatment). Payne (1957), without pre-treatment, found germination rates ranging from 0 % to 94 %; absence of germination, exceptional in the genus, may have been due to seed dormancy or to a specific problem with the cypselas concerned.

The relatively low germination rates of the two annual species assayed (*Artemisia annua*, 52.5 %; *A. tournefortiana*, 56.3 %) is somewhat surprising. Previous tests on one population of the first species (Vallès 1989) gave a slightly higher result (76 %) that still is low, however, for a taxon that depends solely on reproduction by seed. Only the Armenian population of *A. tournefortiana* reached a high (98 %) germination rate. We believe that these annuals may compensate their relatively low germinative power with high individual fruit production, as is current in *Artemisia* (Nosova 1973; Young & al. 1989; Vallès 1989).

No significant decrease in germination rate was noticed during the two-year testing period. We may then conclude that *Artemisia* cypselas keep their germinative power for a long period of time. Our results in this respect are somewhat at variance with those of Ouyahya (1983) who, for other species of the genus, found significant decrease in germinative power (e.g., a drop from 90 % to 59 % between cypselas aged 4 and 11 months, respectively).

We obtained significant data concerning seed dormancy for the two subspecies of *A. umbelliformis*. Subsp. *umbelliformis* must be considered as dormant, because the cypselas of the two populations studied, when sown immediately after collection, did not germinate at all, neither at 15°C nor at 22°C, whereas after a period of c. 3 months they started germinating and eventually reached the highest percentages among all populations tested. In contrast, subsp. *eriantha* may be classified as non-dormant, because the population sown immediately after collection (that from Mt Olympus) presented a very high germination rate (88 %). Cases of dormancy, as reported here, are rather rare in *Artemisia*. Dormancy was reported by McDonough & Harniss (1974) in *A. tridentata* subsp. *vaseyana* Rydb., a N. American taxon. Since cypselas of our other populations were not sown immediately after collection, we cannot tell whether they may show any seed dormancy.

Germination speed is not significantly different among the populations studied, insofar as they show some overlap in this respect. Nevertheless, a slight but clear variation can be noted. Some populations are very quick to germinate, so that an appreciable amount of cypselas will germinate within 2-4 days from sowing; this is the case of both subspecies of *A. umbelliformis,* and of *A. campestris*. In contrast, some others, like *A. vulgaris* and *A. crithmifolia*, start germinating later, 6-8 days after sowing. Also, in some taxa germination of the majority of the cypselas happened in a very short lapse of time (2-3 days, as in *A. umbelliformis* subsp. *umbelliformis*), whereas in others the same process lasted longer (7-12 days, as in *A. crithmifolia*). The values of germinative vigour (time necessary, after sowing, to attain 50 % of the total germination of a given population; Urbano 1992) oscillate between 3 and 17 days. These data are not very different from those obtained by Magherini & Nin (1990: 2-10 days) and Ouyahya (1983: 4-10 days).

To summarize, the germinative power of the *Artemisia* populations studied is fairly high. This conclusion is consistent with the results of other authors on the same genus. On the other hand, the germinative vigour is rather low, and the cypselas keep their germinative ability for a long period of time. These results mean that it is not difficult to propagate plants of *Artemisia* by means of seed, an interesting fact in a genus with many species that are prominent in the landscape and several deserve culturing as medicinal, aromatic or pastoral plants.

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