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Seedling emergence of Mediterranean species in Portuguese wheat and lupin fields

Abstract

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The seed bank of arable fields is the major source for the renewal of weed species. Three field studies were carried out from October 2000 to July 2001 in autumn wheat (*Triticum durum*) and lupin crops (*Lupinus albus* 'MISAK') at Queluz (near Lisbon) and in an autumn wheat (*Triticum durum*) in Alqueva (Alentejo). The methodology applied was that of the European Weed Research Society (EWRS) ex - Working Group "Biology and Ecology of Weeds-Seedbanks and Real Flora of Agricultural Land". The seedling emergence from the soil samples (seedbank) was recorded weekly taking into account the Mediterranean species. The common dominant species in Queluz were *Anagallis arvensis, Euphorbia peplus, Legousia speculum-veneris, Papaver rhoeas, Polycarpon tetraphyllum* and *Polygonum aviculare*, and in the Alqueva *Cichorium intybus, Sinapis arvensis, Sonchus oleraceus* and *Trifolium isthmocarpum.* Knowledge of seedling emergence during the year is an important aspect for the conservation of Mediterranean species like *Legousia speculum-veneris,* that nowdays occurs only in Central-Western of Lisbon region. The Queluz field study will be continued until 2002.

Introduction

Analysis of the weed seed bank has long been recognised as a crucial aspect in studies on weed population dynamics (Dessaint & al. 1996; Caixinhas & al. 2000). Weed communities not only change from year to year, but also change within a season as weeds recruited from the seed bank, become seedlings, and then produce seed as mature plants. Weed community dynamics are the result of ecological and agricultural selection pressures that can be thought of as a series of filters favouring some weeds over others (Parker & al. 1989). As seed survival in the soil and the conditions for germination and establishment of seedlings may differ from species to species, differences between fields and crops can be observed.

Numerous studies have been conducted concerning the knowledge of seed banks (e.g. Dessaint & al. 1996) and the relationships between seed bank and actual weed flora (Caixinhas & al. 1998, 1999).

This paper attempts to investigate and compare the seedling emergence of some Mediterranean species in three fields, during one year.

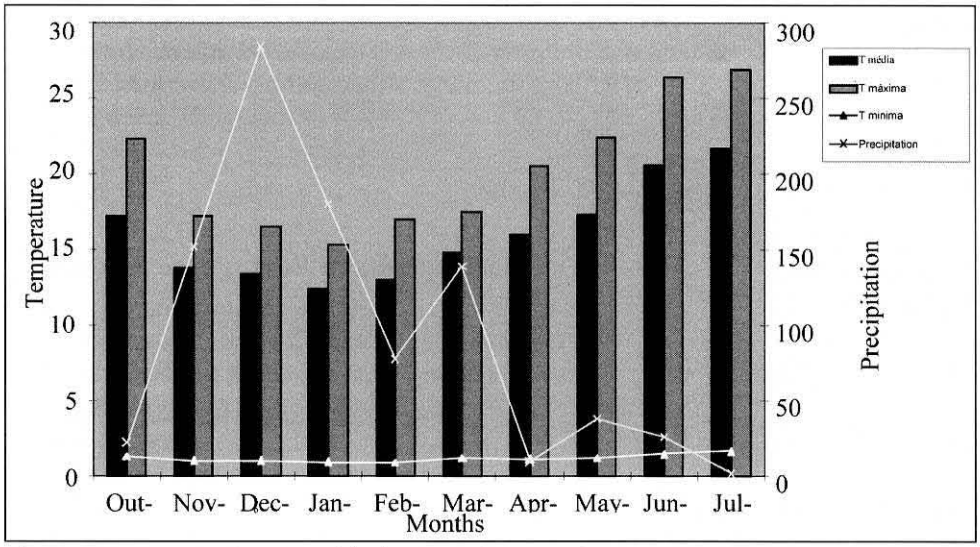

Fig. 1. Temperature (°C) and precipitation (mm) from October 2000 to July 2001.

Material and methods

The study was conducted from October 2000 to July 2001. Three fields, one in Alentejo region (Alqueva) and two in Queluz (near Lisbon), where no previous chemical weed control had occurred, were chosen to study their soil seedbank. In each of them, an area of about 1000 m² was cultivated for autumn wheat and lupin crops at Queluz and for autumn wheat at Alqueva.

Just after the preparation of the seed bed in the fields, one hundred soil sampling units were systematically taken at 1 m intervals (sampling grid, 1 m x 1 m) throughout each sampling area, giving a total of 300 soil samples.

The sampling unit was defined as the volume of soil taken from each point of the grid with a core sampler device with a diameter of 5,0 cm and a depth of about 10 cm.

Samples from Alqueva site were placed in an open greenhouse and those from Queluz in a glasshouse, both located in the Lisbon Technical University Campus (Tapada da Ajuda).

In greenhouse and glasshouse, samples were placed in clay plates of 10 cm diameter with sprinkle irrigation of fine droplets to encourage germination. Temperature inside both sites were different between each one, but those observed in the greenhouse were identical to those in the field. A variation of about ± 4 °C was observed in the glasshouse.

Species were identified according Caixinhas (2001), Caixinhas & al. (2001), Franco (1971, 1984) and Franco & Rocha Afonso (1998).

The number of species emerged by 1 m² (square meter) was calculated having in consideration the surface area of each plate (0,00785 m²). The sum of all sample units from each site covers the area of 0,785 m².

Results

Air temperature (°C) and precipitation (mm) in Tapada da Ajuda during the study period are presented in Figure 1.

During the life cycle of wheat and lupin crops (October 2000 to July 2001) 16 Mediterranean species were identified in the 300 samples of the seed bank study as shown on Table 1. Species are indicated by their botanical name followed by the Bayer code (Bayer 1992; Rocha 1996).

Table 2 compares the periodicity of emergence of the common species in lupin and wheat crops in Queluz. Except *L. speculum-veneris* of lupin crop, all species began germination on November which agrees with Montegut (1975), who refers that all these species can be considered as winter germination. In wheat, germination started in December except *L. speculum-veneris* and *P. rhoeas*, which started germination on February and January, respectively. Only *E. peplus* germinated until July on both crops.

Table 1. Total number of Mediterranean species emerged/m² in different crop fields and regions.

Species/region	Queluz		Alqueva
Crops	wheat	lupin	wheat
Anagallis arvensis L. (ANGAR)	106	62	0
Capsella rubella Reut. (CAPRU)	0	9	0
Cichorium intybus L. (CICIN)	0	0	72
Chrysantemum segetum L. (CHYSE)	0	106	0
Euphorbia peplus L. (EPHPE)	69	136	0
Juncus bufonius L. (JUNBU)	137	0	0
Chaix (LEGSV)	6	9	0
Lythrum hyssopifolia L. (LYTHY)	34	0	0
Papaver rhoeas L. (PAPRH)	46	96	0
Phalaris brachystachys L. (PHABR)	18	0	0
Phalaris coerulescens Desf. (PHACO)	0	10	0
Polycarpon tetraphyllum (L.) L. (POYTE)	49	188	0
Polygonum aviculare L. (POLAV)	27	90	0
Sinapis arvensis L. (SINAR)	0	0	417
Sonchus oleraceus L. (SONOL)	0	0	2
Trifolium isthmocarpum Brot. (TRFIS)	0	0	142

The higher level of germination occurred on *P. tetraphyllum* on January, in lupin crop (101).

Table 2. Seedling emergences of Mediterranean species (Bayer code) on wheat (W) and lupin (L) crops.

Months/Species	ANGAR		EPHPE		LEGSV		PAPRH		POLAV		POYTE	
Crops	W	L	W	L	W	L	W	L	W	L	W	L
Nov 00	0	29	0	2	0	0	0	78	0	24	0	8
Dec 00	7	8	3	5	0	0	0	0	8	29	5	19
Jan 01	85	5	1	25	0	0	38	10	17	18	18	101
Feb 01	9	14	6	9	4	8	7	6	2	15	12	38
Mar 01	4	4	4	3	2	1	0	1	0	3	5	12
Apr 01	1	2	7	1	0	0	0	0	0	1	3	4
May 01	0	0	1	2	0	0	0	0	0	0	1	4
Jun 01	0	0	36	9	0	0	1	1	0	0	5	2
Jul 01	0	0	11	80	0	0	0	0	0	0	0	0

L. hyssopifolia and *J. bufonius* germinated from January to June and *P. brachystachys* germinated in January (Fig. 2) only on wheat crop. On the other hand, *P. coerulescens, C. segetum* and *C. rubella* germinated from November to February only on lupin crop. *P. coerulescens* presented the same germination pattern mentioned by Catizoni & Viggiani (1980) (Fig. 3).

The germination percentage of *C. intybus*, *S. arvensis*, *S. oleraceus* and *T. isthmocarpum* from Alqueva site can be observed in Figure 4. *S. arvensis* and *C. intybus* had a

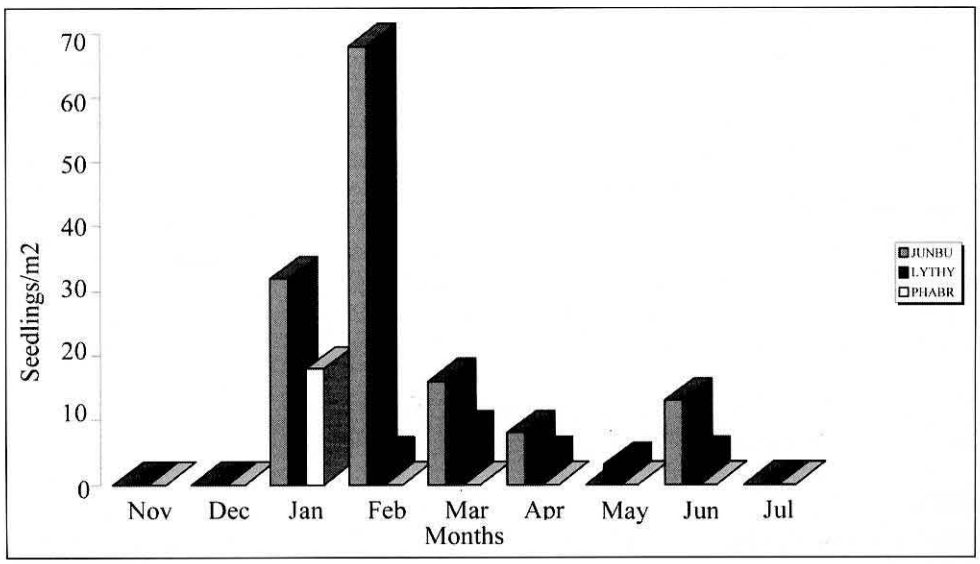

Fig. 2. Seedling emergence of Mediterranean species from wheat crops in Queluz.

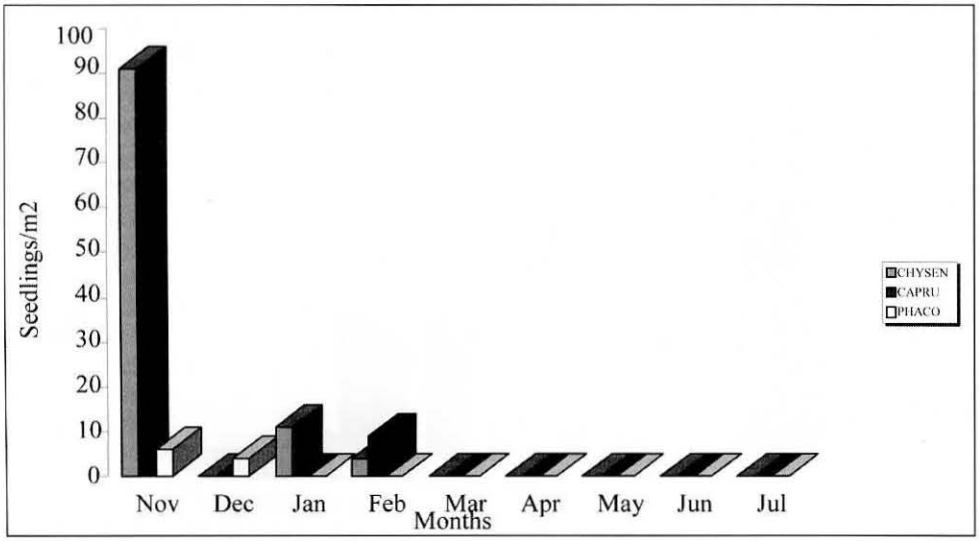

Fig. 3. Seedling emergence of Mediterranean species from lupin crop in Queluz.

high germination level just after the first rains, while *T. isthmocarpum* showed a completely different pattern behaviour comparing with the other species.

Discussion

According to Catizoni & Viggiani (1980) on *Phalaris* spp. most of the germination occurs in autumn, nevertheless Caixinhas (1988) observed that under Portuguese conditions *P. brachystachys* can be considered as an autumn-winter species.

J. bufonius and *L. hyssopifolia* showed a similar germination pattern from January to July, probably due to the sprinkle irrigation and high temperatures during this period. *C. segetum* showed a high level of germination on November followed by a scarce germination on January and February, which agrees with Caixinhas (1988).

Among the taxa studied on both crops sites of Queluz high levels of germination were found of *P. rhoeas* , that unfortunately is decreasing in many European regions, as a consequence of intense use of herbicides in cereals. Due to its beauty, this species is nowadays being preserved in Portugal as an ornamental species. Also *P. tetraphyllum* presented high levels of germination in Queluz in both crops. This species is frequently found in non-cultivated areas (nearby roads) and concerns exist about its preservation. The high level of pollution caused by traffic in the highways and roads may decrease either the germination or the seedling growing.

Alqueva site is no more an agricultural area. A dam was constructed in that place, being this study the last about seedbank in wheat there.

All the species studied in our work can be considered weeds of cultivated crops, nevertheless *Legousia speculum-veneris* in Portugal occurs only in Central-Western of Lisbon region. So, the knowledge of the seedling emergence during the year is an important aspect for conservation of this Mediterranean species. Indeed, in many reserves the desire to protect

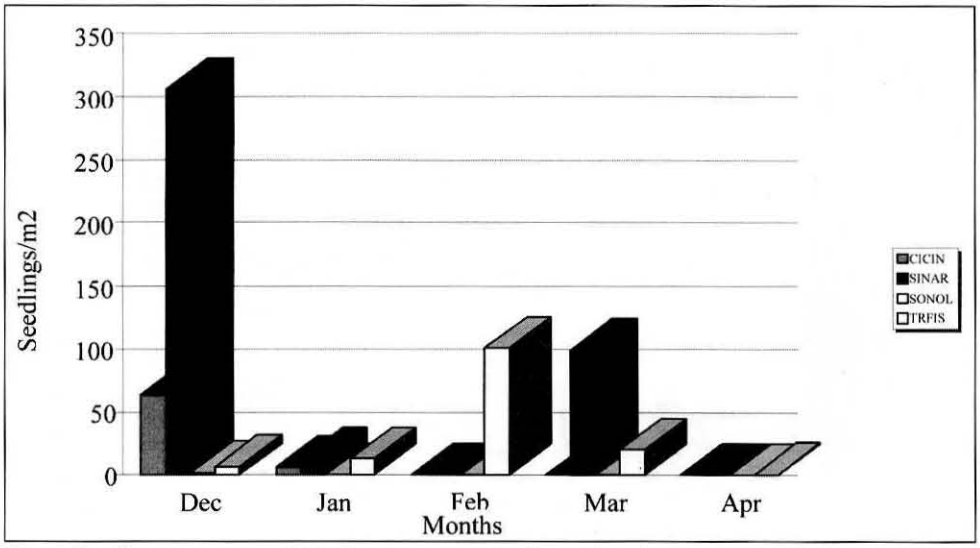

Fig. 4. Seedling emergence of Mediterranean species from wheat in Alqueva.

particular rare species may be the major biological focus of conservation efforts (Frankel & al. 1995).

Each species may have its own requirements for optimal germination. Nevertheless, manipulation of soil samples may greatly increase the germination of seeds incorporated (Post 1984). It is also possible to conclude like Bouwmeester & Karssen (1996) that a study of the seedbank may be a valuable addition to rare plant populations studies and obviously to the Mediterranean species.

Acknowledgements

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