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Seed Germination of *Typha subulata* in Relation to Weed Management

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ABSTRACT

The effects of light and temperature on germination of *Typha subulata* were examined under a combination of various temperature and light regimes. The influence of different storage environments was studied by placing the seeds in the dark under air-dry conditions or immersed in water at 4 ± 1 and 21 ± 3C and tested for germination after 6 and 14 months. The significance of salinity was assayed by incubating the seeds in sodium chloride solutions. The seeds of *T. subulata* exhibited a high potential for germination (88 to 98%) in a wide range (10 to 35C) of continuous or alternate temperatures. After the 6-month-storage pretreatment, germination was close to 100% in all treatments. The 14-month-old samples showed a germination rate higher than 96% when they were maintained under dry conditions at both temperatures. However, germination decreased to 64% at 4C and 0% at 21C under wet storage. The germination was affected by salinity only at high concentrations. These results indicate that in the irrigation districts of southern Argentina, the infesting potential of this weed could be minimized by disrupting the sexual reproductive cycle and by maintaining wet channel beds during the period of irrigation recess.

Key words: southern Argentina, irrigation districts, germination conditions.

INTRODUCTION

The study area is located in a temperate irrigation area in Argentina, the Valle Inferior del Rio Colorado (62°37'W, 39°23'S), where approximately 90,000 ha of land are irrigated. The average temperature during the coldest month (July) is 1.8C and during the hottest month (January) is 29.6C. The absolute minimum and maximum were -9.5 and 42.9C, respectively. Water comes from the Colorado River and is distributed by a network of 331 km of main irrigation channels and more than 3000 km of secondary and subsidiary farm channels. Water conductivity in the irrigation channels is between 0.5 and 1.5 mS cm^{-1}, and maximum and minimum salinities (mainly sodium chloride) are recorded in winter and late spring, respectively. According to Peinemann *et al.* (1979), water salinity in the area is between 1.0 and 1.5 g l^{-1} in irrigation channels and between 3 and 20 g l^{-1} in drainage channels.

In Argentina, the genus *Typha* is represented by *T. latifolia*, *T. domingensis*, *T. angustifolia* and *T. subulata*. One of the main aquatic weed problems in the irrigation network, particularly in the smaller channels, is infestation by *T. subulata* Crespo and Pérez Moreau. No publications are available on the biology and ecology of the genus *Typha* in Argentina. The taxonomy of *Typha* species in Argentina has been reported by Crespo and Pérez Moreau (1967); however, most of the international literature refers mainly to species other than *T. subulata*.

In *Typha*, the spread of an existing stand is sustained largely by vegetative means, but introduction to uninfested areas usually occurs by seeds, which may remain viable for several years (Spencer and Bowes 1990). Knowledge of the mechanisms which enable the propagules of the species to infest and reinfest the channels will assist in obtaining more

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appropriate control strategies. Therefore, the aim of the present paper was to study the seed germination characteristics of *T. subulata.*

MATERIALS AND METHODS

Mature female spikes were randomly harvested at the study site. As in all the taxa the seeds of *T. subulata* are very small, ranging from 1.5 to 2 mm in length. Seeds were separated from other floral parts by decantation in water, the number of seeds was counted in subsamples and total per spike estimated by weighting.

The effect of light and temperature on germination was examined by placing freshly ripened seeds under a combination of various light and thermoperiod conditions. The influence of different storage environments on seed germination capability was studied by placing the seeds in the dark in paper bags under air-dry conditions (dry) or immersed in water (wet) at 4 ± 1 and 21 ± 3C. After 6 and 14 months they were tested for germination under the optimum conditions found from the above experiment: 20C (dark) - 30C (light) daily thermoperiod and a 10-hr photoperiod. Under the same germination conditions, the significance of salinity was also assayed by incubating freshly harvested seeds in the presence of sodium chloride solutions ranging from 4 g l^{-1} to 20 g l^{-1}.

Five replicates of 50 seeds each were used for each germination trial. The seeds were placed in small (1.4 by 0.8 cm) polyethylene boxes containing 0.5 ml of distilled water, except in the last experiment where water was replaced by the saline solution. Seeds were left to germinate for 15 days; none germinated after the first 10 days. Light was provided by a panel of 20-W fluorescent tubes supplemented with 40-W incandescent bulbs. No damage on seed coats nor fungi or bacterial effects were observed during the experiments.

RESULTS

The estimated number of seeds per inflorescence was 56,000 (± 6,000). There were no differences in the rate of germination when the propagules were exposed in the light to a wide range of continuous or alternate temperatures (Table 1). Light was essential since virtually no germination was observed in its absence. After a 6-month storage pretreatment, germination was close to 100% independent of the storage conditions. The 14-month-old samples maintained under dry conditions showed a germination rate higher than 96% at both temperatures. However, when they were stored under wet conditions their germination decreased to 64 (±2.9) % at 4C and 0% at 21C.

Germination was affected by salinity only at relatively high salt concentrations, above 12 g l^{-1} (Table 2).

TABLE 1. THE EFFECT OF TEMPERATURE AND LIGHT ON THE GERMINATION PERCENT OF FRESHLY HARVESTED SEEDS OF *T. subulata.* VALUES ARE MEAN ± SE.

Daily temperatues during			Daily temperatures during		
10 hr dark (C)	14 hr dark (C)	Germination (%)	10 hr light (C)	14 hr dark (C)	Germination (%)
10	10	0	10	10	92 (±1.7)
25	25	0	25	25	97 (±1.8)
35	35	0	35	35	88 (±2.8)
25	10	0.4 (±0.4)	25	10	97 (±1.8)
30	20	0.8 (±0.9)	30	20	98 (±1.1)
35	10	0.4 (±0.4)	35	10	98 (±1.0)

TABLE 2. GERMINATION OF FRESHLY HARVESTED SEEDS OF *T. subulata* UNDER DIFFERENT CONCENTRATIONS OF SODIUM CHLORIDE. PHOTOPERIOD 10 HR (light) AND THERMOPERIOD 30C (light) AND 20C (darkness). VALUES ARE MEAN ±SE.

Treatments g l^{-1}	Germination (%)
0	99(±1.8)
4	98(±1.7)
8	96(±0.7)
12	95(±3.2)
15	8(±0.5)
20	0

DISCUSSION

Seed production in *T. subulata* is typical of the highly prolific character of the genus, as shown for other species (Yeo 1964, Linde *et al.* 1976). Light was essential for the germination, and this requirement was not partially replaced by alternating temperatures, as was reported for *T. latifolia* (Morinaga 1926). The seeds of *T. subulata* exhibited a high potential for germination (88 to 98%) in a wide range (10 to 35C) of continuous or alternate temperatures. In contrast, germination in seeds of *T. latifolia* was clearly reduced at temperatures below 20C (Sifton 1959).

The salinity of the Colorado River water, sometimes as high as 1.5 g l^{-1}, frequently affects the production of crops. Galinato and Van der Valk (1986) reported a significative germination reduction in *T. glauca* in waters with more than 1 g l^{-1} NaCl concentrations. However, water salinity in the channels is below the concentration that appears likely to constrain the germination of *T. subulata* seeds (Table 2). Tolerance of some *Typha* species to salinity is a known feature (McMillan 1959, Von Oertzen and Max Finlayson 1984).

The number of germinating seeds of *T. subulata* can be influenced by their environment during storage. Wet storage affected the germination capability and the intensity of the effect was temperature dependent: a marked reduction was observed at 4C and no germination was recorded at 21C. Similarly, Comes *et al.* (1978) found higher germination after dry than after wet storages in *T. latifolia* during the first year. Several authors have indicated that the germination ability of *Typha* tends to diminish with age ranging from several months up to more than 5 yr (Croker 1938, Bedish 1967, Smith 1967, Comes *et al.* 1978, Grace 1983).

Colonization of new habitats in the irrigation channels of the area by *T. subulata* is initiated by the germination of seeds which have been most likely transported by the flowing water. This study has shown that the infesting potential of *T. subulata* into new territories may be strongly emphasized by their high seed production, longevity and germination capability in a wide range of environmental conditions. Sobrero (1991) found that a single plant of *T. subulata* initiated from seed germination is able to reproduce sexually and vegetatively during its first year growth cycle (7 to 8 months). The perennation of the genotype in a given location, its expansion year after year, and the annual production of sexual propagules will be secured since the underground structures are persistent.

One management strategy to minimize the seed infesting capacity of this weed would be to interfere with its sexual reproduction, for example by mechanical or chemical procedures that prevent flowering or seed formation. Since fructification is concentrated during a short period in the summer (Sobrero *et al.* 1991), it is not necessary to repeat the treatment during the growing season.

A weed control procedure currently in use is the elimination of patches of *T. subulata* by physical methods during the winter, when irrigation is suspended. During this time the channel beds frequently remain dry. In clearing the channel bed by dredging, seeds previously buried may be brought closer to surface, where they may be exposed to light. In the following growth season, reinfestation with *T. subulata* in the same site will be dependent on the growth of reproductive underground structures not properly eliminated, or by the germination of seeds stored in the seed bank near the surface. New seedling growth in these areas will be free from competition with adult plants. The differences in germination observed in this work when the seeds were stored under dry or wet conditions suggest the possibility of reducing the potential of new infestation in weed-free areas or reinfestation in others previously invaded if the channel beds remain permanently wet even during the interval when they are not used.

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