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Effect of Storage at low Temperature on the Germination of the Waterchestnut (*Trapa natans* L.)

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With 2 Figures

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Summary

R. COZZA, G. GALANTI, M. B. BITONTI & A. M. INNOCENTI 1994. – Effect of storage at low temperature on the germination of the waterchestnut (*Trapa natans* L.) – Phyton (Horn, Austria) 34 (2): 315–320, 2 figures. – English with German summary.

The effect of storage at low temperature (4° C) on the germination of *Trapa natans* seeds was investigated. Optimum of germination occured in a temperature range of 15–25° C. An enhancement of germination was obtained by the cold treatment during the dormancy period whereas, on the spring period, when the germination capability is beginning, no effect was detected. In the seeds analyzed, a long-lasting germination behaviour was identified which might be of ecological significance.

Zusammenfassung

R. COZZA, G. GALANTI, M. B. BITONTI & A. M. INNOCENTI 1994. – Der Einfluß der Lagerung bei niedrigeren Temperaturen auf die Keimung der Wassernuß (*Trapa natans* L.). – Phyton (Horn, Austria) 34 (2): 315–320, 2 Abbildungen. – Englisch mit deutscher Zusammenfassung.

Es wurde der Einfluß der Lagerung bei niedriger Temperatur (4° C) auf die Keimung von Samen von *Trapa natans* untersucht. Das Optimum der Keimung liegt im Temperaturbereich um 15–20° C. Durch Kältebehandlung während der Samenruhe

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kann die Keimung gesteigert werden, wobei im Frühjahr, wenn die Keimungsbereitschaft beginnt, kein Effekt zu beobachten ist. In den untersuchten Samen wird ein Langzeitverhalten der Keimung festgestellt, welches von ökologischer Bedeutung sein könnte.

Introduction

In seeds of aquatic macrophytes, both the recovery of dormancy and the ability to germinate can be affected by environmental factors as restriction and quality of light, water temperature, nutrient availability, photoperiod (Gopal & Sharma 1983, Else & Riemer 1984, Baskin & Baskin 1985, Yeo 1986, Atkins & al. 1987, Coble & Vance 1987).

Presently, the factors controlling the germination capability of aquatic plants seeds, such as *Trapa natans*, aroused particular interest especially related to the utilization of this species to reduce nutrients in wastewater effluents (Galanti & Guilizzoni, 1985).

The aim of this study was to investigate the germination behaviour of the waterchestnut seeds, when maintained in both lake and low temperature conditions, in order to determine the effects of storage on seeds germination and viability.

Material and Methods

Seeds of *Trapa natans*, harvested in October 1989 along the shore of Lake Candia (Northern Italy), were used. The collected seeds were separated in two lots: the first one was placed in nets suspended in the lake, the second one was immersed in tap water in plastic containers and stored in an environment-controlled chamber, in complete darkness at 4° C. Preliminary germination tests allow us to identify the range-temperature (15–20° C) at which the maximum of germination took place. Different light-dark cycles were also tested but no significant influence on the germination was detected.

Germination tests were carried out from October 1989 to March 1990 at monthly interval. For both the two lots, five replicates of 20 seeds each, were carried out placing the seeds in plastic containers filled with tap water, in a temperature-controlled incubator at 18° C. Germination was verified daily up to a period of one month. The percentage of root protrusion was the criterion used to evaluate germination. During the germination assay all the seeds incapable to germinate were stored at low temperature, as previously described, and tested again succesively.

Results and Discussion

Immediately after harvesting (October and November) neither the seeds stored in lake nor those stored at 4° C were able to germinate, thus indicating the presence of a deep dormancy state. After this period, notably differences were observed in the germination capability of seeds stored in different conditions (Fig.1). In particular, in December, just at the end of the dormancy period, the seeds from the lake showed a delay of ab-

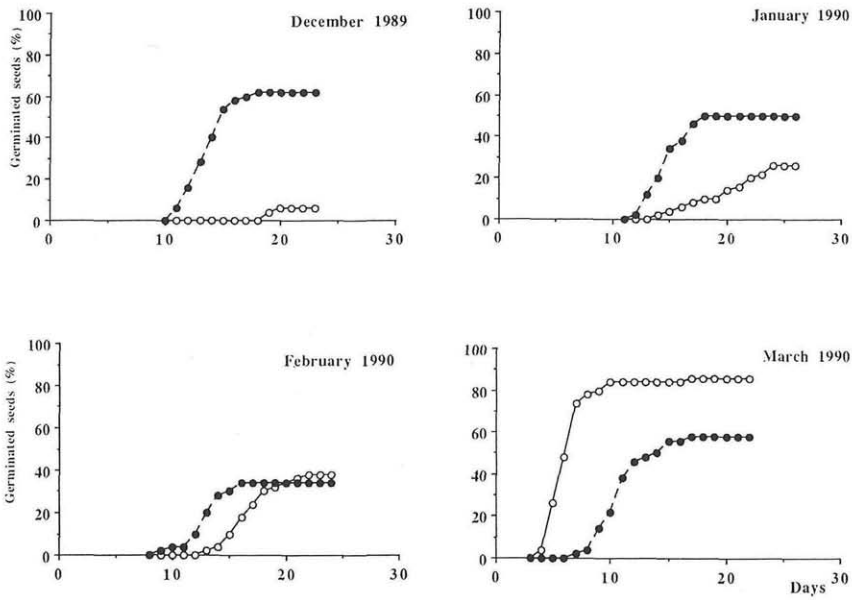

Figure 1. The time course of germination (%) of *Trapa natans* seeds. Solid line (- o -), germination of seeds stored in the lake; broken line (- ● -), germination of seeds stored at 4° C in the environment-controlled chamber.

out 10 days in the germination time and lower percentages of germinated seeds (6%) with respect to the seeds stored at low temperature (60%). A slightly different trend occurred in January when the germination capability of the lake-seeds increased (26%) even if the delay in the onset of germination was still present. In February the lake-seeds, after a natural cold period, released their dormancy and started to germinate at the same time as the seeds stored in controlled low temperature. The final germination percentage achieved the same value of the cold-chamber seeds (40%).

Finally in March a full recovery of lake-seeds was observed: infact both the germination percentage (86%) and germination energy appeared greater in the lake-seeds than in the cold-stored seeds.

The seeds which were unable to germinate immediately after harvesting, stored for six months in different conditions, showed clear differences in the germination pattern. Infact the seeds that did not germinate in October, when stored in laboratory condition showed a germination percentage higher (54%) than the seeds maintened in the lake (42%) (Fig. 2a). In the meantime, ungerminating seeds of November not only recovered their germination capability (82%), but surpassed the values reached by seeds stored at laboratory condition (68%) (Fig. 2b).

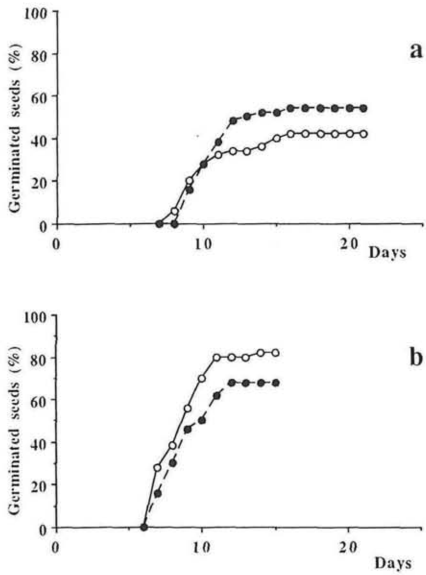

Figure 2. Influence of the storage time and stratification on the germination of the *Trapa natans* seeds just tested in October 1989 a) and in November 1989 b). Solid line (-o-), lake-stored seeds; broken line (- • -), controlled-chamber stored seeds.

Regarding the seeds which were unable to germinate, assayed again in the following years (May '90 and May '91) showed a very high germination percentage (Table 1).

Table 1
Germination percentage of unable germinating seeds of *T. natans* tested again in the following years.

Date of storage of ungerminated seeds		Time test	
		May 1990	May 1991
December 1989	Lake	94 ± 2.4	68 ± 9.6
	Cold-chamber	80 ± 10	100 ± 11.5
January 1990	Lake	62 ± 11.6	82 ± 10
	Cold-chamber	96 ± 4	100 ± 9.6
February 1990	Lake	100 ± 8	
	Cold-chamber	57 ± 10	75 ± 11.8
March 1990	Lake	81 ± 8.3	50 ± 8.2
	Cold-chamber	60 ± 7.8	100 ± 10

The results obtained suggest that the storage temperature may affect positively the germination pattern of seeds only in the course of the dormancy period. Infact, by storing seeds at 4 °C into environment-controlled chamber, an enhancement of germination values may be obtained (Fig.1). On the contrary in the spring period, being the germination capability naturally increased, no effects due to the cold treatment were detectable.

A period of chilling is necessary to break dormancy in *T. natans* seeds, very probably due to additional ripening during the cold exposure (KOLLER, 1972). In particular, the ability to germinate after a sufficiently long stratification period is of high adaptive significance ensuring good timing for the onset of germination in spring time.

It is noteworthy that some *T. natans* seeds subject to a cold period are unable to germinate in spite of the treatment; the same seeds tested in the following year germinate in high percentage (Table 1). These results suggest that waterchestnut plants produce physiological heteromorphic seeds which could be able to germinate after going another winter. Germination-spreading mechanisms described also in hydrophytes (AGAMI & WAISEL 1984), prevent destruction of whole populations in extremely unfavourable conditions.

This germination strategy will favour an higher proportion of dormant seeds among the progeny of each plant-mother, a behaviour commonly referred as risk-spreading (HAIG & WESTOBY 1988, BROWN & VENABLE 1986). It is well known from literature that environmental and maternal conditions occuring during maturation or due to seed position of the seed on the mother plant, as well as to storage conditions, influence the production of heteromorphic seeds which differs in seed dormancy which is related to seed longevity (ROBERTS 1963, TOOLE & TOOLE 1953).

The above results indicate that also in *T. natans*, the parental plant is capable to produce seeds having the same genotype but differing in dormancy behaviour. *Trapa natans* plants also produce seeds exhibiting a long-lasting germination behaviour (Table 1). It would be of interest to identify the conditions which determine their release from dormancy with the aim to establish whether it is possible to have lots of constantly available germinating seeds.

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Phyton (Horn, Austria) 34 (2): 320 (1994)

Recensio

KLÖTZLI Frank A. 1993. Ökosysteme. Aufbau, Funktionen, Störungen. 3., durchgesehene und ergänzte Auflage. – Uni-Taschenbücher 1479. – Kl. 8°, X + 447 Seiten, 182 Abbildungen, 96 Tabellen; brosch. – Gustav Fischer Verlag Stuttgart, Jena. – DM 44,80. – ISBN 3-8252-1479-6.

Diese allgemeine Ökologie unter besonderer Berücksichtigung der durch den Einfluß des Menschen verursachten Störungen und der daraus resultierenden Probleme wurde in 2. Auflage in Phyton 30 (2): 332–333 besprochen. Da sich an Inhalt und Aufbau nichts Grundsätzliches geändert hat, sei diesbezüglich auf diese Rezension verwiesen; lediglich die 15 Seiten Glossar der 2. Auflage wurden weggelassen. Die Neuauflage hat, was selten vorkommt, weniger Seiten (–17), aber Abbildungen und Tabellen sind stark vermehrt (+ 16 bzw. + 9). Der Text wurde stark umgearbeitet und neuen Ergebnissen, neuen Trends und neuen Erfordernissen in der Ökologie-Ausbildung angepaßt. Nach dem Vorwort lagen dem Autor dabei die Aufnahme von Chaostheorie, Selektivitätstheorie und Mosaik-Zyklen-Konzept sowie Fragen im Zusammenhang mit Evolution, Treibhauseffekt und Waldschänden besonders am Herzen. Es ist erfreulich, daß dieses offensichtlich bewährte Buch, das vom Umfang der Darstellung her nicht die Theorien in den Vordergrund stellt, sondern durch viele konkrete Beispiele den Stoff anschaulich zu machen sucht, in aktualisierter Form weiter zur Verfügung steht.

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