SEED GERMINATION OF TWO CATTAII (TYPHA) SPECIES AS A FUNCTION OF EVERGLADES NUTRIENT LEVELS

Herbert Stewart, Shi Li Miao, Marsha Colbert, and Charles E. Carraher, Jr.

1 Department of Biological Sciences
Florida Atlantic University
Boca Raton, FL 33431

2 Everglades System Research Division
South Florida Water Management District
West Palm Beach, FL 33406

3 Department of Chemistry
Florida Atlantic University
Boca Raton, FL 33431 and
Florida Center for Environmental Studies
NorthCorp
Palm Beach Gardens, FL 33410

Abstract. Sawgrass (Cladium jamaicense) is being replaced by cattails (Typha domingensis and Typha latifolia) in Water Conservation Area 2A (WCA 2A) of the Florida Everglades. This replacement coincides with changes in nutrients in WCA 2A. Investigating seed germination of Typha in response to different nutrient levels, focusing on phosphate, might help in understanding how this replacement occurs. Three sets of experiments with seed germination were conducted. Series I, a pilot study, was run to set the parameters for further investigations using Typha domingensis. Germination up to 100% was obtained. Series II used field water collected from three areas of WCA 2A that differed in the concentration of phosphate. These three areas represented high, medium, and low nutrient conditions with total phosphates that ranged from 0.200 to 0.008 mg/liter. Distilled water was used to create a zero nutrient condition. Typha domingensis and T. latifolia seeds were used. Little difference in germination percentage was found between T. domingensis and T. latifolia. Germination began after three days, reaching 22% to 40% in seven days. In high nutrients, however, T. latifolia germinated faster. In Series III, distilled water was used that had phosphate levels added corresponding to the concentrations found in WCA 2A. This water was used in place of the field water, which was used in Series II. In Series III, only T. domingensis seeds were used. No difference was found in seed germination as the phosphate concentration was varied. Germination began after three days, reaching about 40% in seven days. Seed and “fruit” traits were also measured. T. latifolia produced 1.4 times as many seeds as T. domingensis, but the mean seed weight of T. domingensis was 3.5 times that of T. latifolia. Results suggest that both cattail species can germinate under a variety of phosphate levels. Thus, both T. domingensis and T. latifolia may be long-term threats to areas in the Everglades presently occupied by sawgrass.

Key Words: Typha domingensis, Typha latifolia, Everglades, seed, germination, nutrient concentration

INTRODUCTION

The Everglades is a subtropical, freshwater wetland ecosystem dominated by sawgrass (Cladium jamaicense Crantz) marshes that historically covered about 60%–70% of the Everglades (Davis 1943, Loveless 1959). This ecosystem is undergoing change involving the replacement of sawgrass by cattails (Typha spp.). Typha domingensis Pers., was found historically in small patches in the Everglades but has spread and threatens to replace sawgrass as the dominant species in the northeastern section of Water Conservation Area 2A (WCA 2A). T. domingensis dominated about 2,000 ha in early 1980. This number increased to almost 7,200 ha in 1992 and is increasing (Davis 1994). Typha latifolia L. is probably a recent arrival because it has been found only in isolated areas of WCA 2A. Since the recent vegetation changes in the Everglades coincide with anthropogenic nutrient additions and hy-
droperiod fluctuations, a study addressing the impacts of these alterations on the vegetation is useful in prospective ecological reconstruction. Stabilization and re-establishment of the Everglades ecosystem has only recently been initiated (Everglades Forever Act 1994). Information on Typha seed germination may be useful in describing conditions that will discourage cattail invasion of current sawgrass sites and favor restoration of sawgrass.

The effects of environmental variables such as oxygen, light, and potential allelopathic inhibition on seed germination of different species of Typha have been studied by several authors. Without light, seed germination of T. latifolia was 0%-10%, whereas with light, seed germination increased to 91%-100% (Sifton 1959). High percentages of germination of T. latifolia required long exposure to light, low oxygen concentrations, and high temperatures (Bonnewell et al. 1983). Changes in pH had no effect on T. latifolia germination, and green leaf extract inhibited germination in the dark only (Rivard and Woodard 1989).

A variety of aqueous extracts, including those from Typha, did not affect the seed germination of T. angustata Bory et Chaub (which has since been recognized as a synonym of T. domingensis by Smith 1987) (Sharma and Gopal 1978). There is a question with respect to allelopathic inhibition. Results of inhibition experiments indicate that there was no allelopathic inhibition of germination as found by McNaughton (1968) (Grace 1983). Instead, it was suggested that McNaughton’s (1968) data showed that allelopathy inhibited seedlings rather than seeds. Germination of T. latifolia seeds decreased after they were buried in substrate by tubificid worms (Grace 1984). These same factors, light, chemicals, and substrate, were explored in our pilot studies, but the effects of nutrient levels was the primary focus.

The present study addresses the effects of nutrient concentrations on Typha seed germination. It is part of an ongoing investigation involving a comparison of sawgrass and cattails. Similarities and differences in seed germination are examined to facilitate restoration of sawgrass and curtailment of both species of cattails. This study includes a determination of each Typha species’ seed weights and yields, pilot studies, and two experiments to evaluate the importance of nutrient levels as a factor in germination. The pilot studies evaluated germination of T. domingensis under variations in light intensity, substrate type, and nutrient levels. Series II explored the effects of differences in field-derived nutrients on germination in T. domingensis and T. latifolia. Series III explored the effects of variations in added phosphorus alone on T. domingensis seed germination.

METHODS

Study Site and Subjects

The study area is located in Water Conservation Area 2A (WCA 2A), a 44,500-ha region of the northern Everglades in southern Palm Beach and northern Broward Counties, Florida. WCA 2A can be divided into three general areas based on the phosphorus concentrations in water and soil and on the vegetation present. These are a) Impacted, where the relative phosphorus level is high (between approximately 0.1 and 0.3 mg/L), with 90% cattail coverage; b) Transitional, where the phosphorus level is moderate (less than 0.05 mg/L), with mixed cattail and sawgrass; and c) Reference, where the phosphorus level is low (between approximately 0.001 and 0.008 mg/L), with few patches of cattail (Miao et al. 1997). T. domingensis was found in all three areas, while T. latifolia was found in only the impacted area. Seeds of both species used in this study were collected from the impacted areas of WCA 2A in June, 1994.

Two species differ primarily in reproductive characters, such as the color, size, and relative positions of the staminate and pistillate spikes (Table 1). There also is extensive genetic variation within the species of Typha, which can be correlated to differences in climate and soils (McNaughton 1966).

Water and Nutrients

Field-derived water supplied the initial nutrient levels for the high, medium, and low conditions in Series II. The major difference among the water samples collected was their phosphorus concentration, although other variations existed (Table 2). Total phosphorus in the water collected in the impacted area was 25 times greater than that collected in the reference area (0.200 compared to 0.008 mg/liter).

For Series III, the experimental phosphate concentrations added corresponded to the Series II range from 0.200 to 0.008 mg/liter. Three levels within the range were used and were labeled high, medium, and low nutrient conditions. Their pHs were adjusted to between 7.0 and 7.2, the range typically found in the field water used in Series II, by varying the ratio of the phosphate (NaH,PO and Na,P) employed. Distilled water was used for the zero nutrient condition in both Series II and Series III. It was buffered to a pH of 7 using an acetate buffer.

Seed and “Fruit” Trait Measurements

Typha species have minute, one-seeded fruits with numerous, persistent perigonal hairs. They have been variously described as achenes and nutlets, but micro-