Physiological Adjustments of Cattail (*Typhus sp)* in Water with Higher Nutrient Levels

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Abstract

The objective of this experiment was to observe any physiological changes in cattail (*Typhus sp*) in the four cells, or sections, of the Lake Waco Wetlands. In most wetlands, nitrate and phosphate levels decrease from one cell to the next as water moves farther away from the source. Discovering a difference in the ability of cattail to absorb nutrients would allow for better wetland purification, as a system of plant rotation within the wetlands to maximize the nitrate-absorbing abilities of cattail could be implemented.
The hypothesis presented was that cattail plants in a cell closer to the North Bosque River would have greater nitrate-reducing abilities than plants in the following cells. This is because these plants are exposed to more nitrogen on a regular basis. Verification of this hypothesis would indicate that a physiological change had occurred in cattails present in the Waco wetlands. To test this hypothesis, plants from cells two to four were collected and transplanted into mesocosms containing water from the in-flow cell, i.e., cell one. Nitrate and phosphate levels were measured over a four-week period.
The preliminary results we obtained from the nitrate tests supported the hypothesis. Nitrate levels greatly decreased in cell two while these levels remained relatively constant in cell three and cell four. We concluded that plants in cell two had better nitrogen-reducing abilities because they had adapted better to the high nitrogen levels in cell two. The second cell contained water that had not been filtered yet, as it had not yet passed through the wetlands. Cell four, however, did not contain such high nutrient levels. Therefore, when plants from this cell were exposed to high nutrient levels in this experiment, they were unable to filter nutrients at a comparable rate to those plants from the second cell. However, the results obtained from the phosphorus tests revealed no clear trends and were therefore inconclusive.

Introduction

Due to concerns about nitrogen and phosphorus pollution, constructed wetlands have stimulated interest in the scientific community. It is known that physical, chemical and biological factors influence the removal of nitrogen and phosphorus both spatially and seasonally and this removal efficiency varies throughout the year (Kallner S. and Wittgren H. B. 2001). It has also been stated that wetland plants play vital roles in the filtration and purification of water. The biological and chemical processes of wetland plants tend to remove nutrients with an efficiency rate between 70% and 90% (Reilly 1991; Gilliam 1994).

Certain plant species, such as cattail (*Typhus sp.)* have been shown to reduce the levels of nutrients in the wetlands (Grebermariam and Breutel, 2008). There is an influx of nutrients into the wetlands from the Bosque River. Due to filtration, however, there will be a significant decrease in the levels of both nitrogen and phosphorus as the water progresses through the wetlands. Therefore, wetland water will be cleaner as it moves further away from the Bosque River. Because of filtration as water progresses through the wetlands, plants in the later cells are exposed to lower nitrogen and phosphorus levels. If plants from later cells are moved and exposed to water from the Bosque River, high in nitrogen and phosphorus, it is hypothesized they will be unable to adapt to the new environment. If this is the case, it will prove that some sort of physiological change has occurred in cattails between the beginning and at the end of the wetlands. The aim of this investigation is to quantify changes in plant physiology, and to develop better guidelines for wetland design.

Fig. 1 Experimental Set Up

Fig. 2 Nitrogen Levels in Wetland Mesocosms

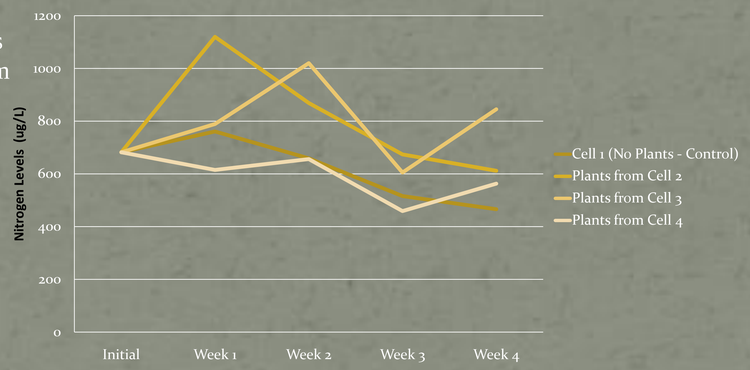
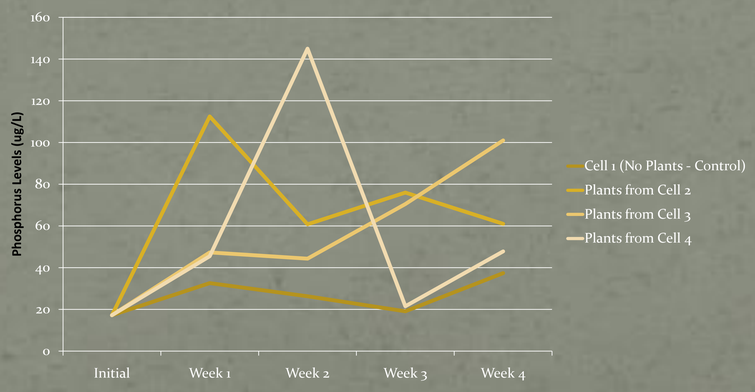


Fig. 3 Phosphorus Levels in Wetland Mesocosms



Protocol and Materials

Three cattail plants of approximately equal size were collected from each cell. However, no cattail plants were present in the in-flow cell , so none were collected. The roots of the plants were washed to remove any soil. Each plant was placed in a small plastic bucket and its roots held down with stones. Each set of three plants collected from each cell was then placed in an 29.2 cm x 29.2 cm x 101.6 cm plastic mesocosm containing water from in-flow cell (Fig. 1). Since no plants were collected from the in-flow cell i.e. cell one, Mesocosm one contained no plants and served as the control. All the mesocosms contained an equal amount of water; the initial water level in each mesocosm was marked.
The plants were allowed to adjust to their new environment. Samples were taken from each mesocosm over a three-week period to test nitrate and phosphate levels. In order to account for water loss due to evaporation, an equal amount of water from the inflow cell was added weekly to each mesocosm to bring it up to the initial water levels in each mesocosm.

Discussion and Conclusion

Mesocosm two had the highest nitrate levels while nitrate levels in Mesocosms three and four remained fairly constant (Fig. 2). This data supports the hypothesis that plants in cell two had physiologically adapted to the high nitrate levels in the cell. Variations in nitrate levels (Fig. 2) were most likely due to the addition of water from the inflow cell each week to maintain adequate water levels for plant survival. As a result, nitrate levels peaked before diminishing each week.
Also, rainfall during the second and third weeks of the experiment may have increased nitrate levels in each mesocosm considerably. The accumulation of microbes and invertebrates in the mesocosms may also account for discontinuities in the data.
The data also suggests while cattail may contribute to nitrate removal in the wetlands, it may not have the same effect on phosphates. Phosphate levels in the mesocosms showed no general trend . However, because these levels were very low in each mesocosm (ranging from 17.2 ug/L to 112.5 ug/L) (Fig. 3), we concluded that any variation in environmental conditions could have altered the data greatly.

Literature Cited

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