Comparative Germination of Alfalfa, Purple prairie clover and Green needle grass under Constant and Alternating Temperatures

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Key Words: seed germination, thermal gradient plate, alfalfa, purple prairie clover, green needle grass

Objective

The objective of this project was to investigate seed germination requirements of alfalfa (*Medicago falcata*), purple prairie clover (*Dalea purpurea*) and green needle grass (*Nassella viridula*) under constant and alternating temperatures, similar to those temperatures found in a prairie environment. Results of this research will provide a better understanding of the requirements for successful species regeneration on the prairies.

Introduction

Predicted changes in future climate put the endangered native prairie at risk. It is important to know under what conditions perennial species (native and introduced) will establish. Temperature is an important factor for seed germination. In order to further understand the germination requirements of seed of native prairie species, SPARC utilizes the Thermal Gradient Plate (TGP), featuring 96 cells with individual cell temperature control. Each individual cell is monitored with an accuracy of ±0.2°C. The TGP allows for simulation of prairie temperatures of present day as well as those predicted for the changing climate.

Materials and Methods

Species were selected for their hard seed characteristics. A full factorial randomized complete block statistical design with four replicates was utilized into the TGP. Germination tests were conducted with designated temperature treatments of 1) constant 11°C, 2) constant 21°C and 3) oscillating night and day temperatures of 11°C and 21°C respectively. Temperatures were monitored using the TGP management computer readings and a thermocouple.

Fifty scarified seeds were placed in a petri dish lined with two pieces of filter paper (Whatman 597), moistened with distilled water, but with no pooling of water. A single piece of filter paper was placed on top of the seeds. Each plate was placed in its own individual cell in the TGP, with the assigned temperature treatment. The test ran for 28 days; germination counts were performed daily, recorded and germinated seeds removed. A seed showing a radicle of greater than 2 mm was considered to have germinated.

Results and Discussion

The cooler temperature of 11°C delayed the germination rate of all the species but not overall germination (Table 1). This could impact the ability of the plants to compete with non-desirable plant species. Overall, green needle grass was slower to germinate than alfalfa or purple prairie clover (Table 1). Green needle grass also responded to alternating temperatures whereas alfalfa and purple clover did not (Table 2). Purple prairie clover did respond slightly slower at a lower temperature than the alfalfa, indicating a possible preference for higher temperatures, which is indicative of a warm season growth pattern. (Table 2).

Table 1: Measured parameters for germination of Green needle grass (GNG), alfalfa (A) and purple prairie clover (PPC) germinated at a constant 11^{o}C, a constant 21^{o}C and a night temperature of 11^{o}C with a day temperature of 21^{o}C.

Factor	% Germination	Days to 1st Germination	Days to Maximum Germination	Day of Highest Germination
Plant species				
(A)	77.5	1.9	2.5	3.6
(GNG)	24.3	6.8	11.0	12.0
(PPC)	77.5	2.7	3.8	4.8
Prob>F	<0.0001	<0.0001	<0.0001	<0.0001
Temperature				
11^{o}C	56.6	3.1	9.1	10.1
21^{o}C	60.4	2.4	3.5	4.4
11^{o}C/21^{o}C	62.5	5.8	4.7	5.7
Prob>F	0.1115	<0.0001	<0.0001	<0.0001

Table 2: Temperature effects (a constant 11^0C, a constant 21^0C and a night temperature of 11^0C with a day temperature of 21^0C) on alfalfa (A), green needle grass (GNG) and purple prairie clover (PPC).

Plant Species	% Germination	Days to 1st Germination	Days to Maximum Germination	Day of Highest Germination
(A)				
Temperature				
11^0C	74.5	2.5	3.1	4.3
21^0C	76.5	1.5	2.3	3.3
11^0C/21^0C	81.5	1.6	2.3	3.3
Prob>F	0.4653	0.0035	0.0080	0.0005
(PPC)				
Temperature				
11^0C	80.0	4.9	6.4	7.4
21^0C	76.3	1.3	2.1	3.1
11^0C/21^0C	76.3	1.9	3.0	4.0
Prob>F	0.4986	<0.0001	<0.0001	<0.0001
(GNG)				
Temperature				
11^0C	19.8	9.4	16.8	17.8
21^0C	24.0	4.6	6.0	7.0
11^0C/21^0C	29.8	5.9	8.9	9.9
Prob>F	0.1183	0.0135	0.0009	0.0009

Conclusions

The results show that temperature strongly influences seed germination. The legumes tested appear to not respond to alternating temperature and germinate more quickly than green needle grass. Purple prairie clover did have a warm season type response with a higher germination requirement than alfalfa.

Acknowledgments

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Introduction

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Materials & Methods

- The test had 3 three treatments: constant 11°C, constant 21°C and oscillating night and day temperatures of 11°C and 21°C respectively
- Test was a full factorial randomized complete block design input into the TGP operating system
- Each plate was placed in its own individual cell on the TGP, with the assigned temperature treatment
- Temperatures were monitored using TGP computer readings and a thermocouple
- 50 scarified seeds were placed on a petri dish lined with 2 pieces of filter paper moistened with distilled water, but with no pooling of water. A single piece of moistened filter paper was placed on top
- Test ran for 28 days in darkness; the test was run twice for verification purposes
- Germination counts were performed daily and recorded
- Germinated seeds were discarded after being counted

Results & Conclusions

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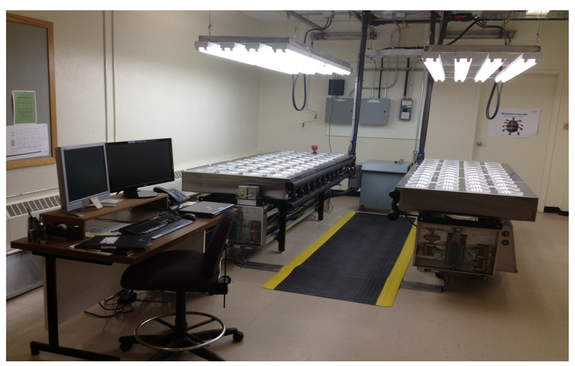

Thermal Gradient Plate at SPARC

Alfalfa (*Medicago falcata*)

Purple prairie clover (*Dalea purpurea*)

Green needle grass (*Nassella viridula*)

- Overall, green needle grass was slower to germinate than alfalfa or purple prairie clover
- Green needle grass also responded to alternating temperatures; alfalfa and purple prairie clover did not
- Purple prairie clover did respond slightly slower at a lower temperature than the alfalfa indicating a possible preference for higher temperature.
- Temperature strongly influences seed germination.
- The grass used in this study appears to require oscillating temperature whereas the legumes do not.

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