Parasitic Preference of Dodder Plants

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Introduction

The dodder is a plant that has little or no chlorophyll, no root system, and parasitizes other plants in order to gain vital nutrients that it needs to survive. It parasitizes other plants by producing sucker like projections from its stem to steal nutrients. There are very few instances where studies have been done on the specific lengths of browsed or broken dodder that stay viable when detached form the parent plant and are able to survive independently. Many research projects look at the parasitic choice of the newly germinated seed shoots. Other instances of studies have been done on the parasitic response in dodder plants, but these experiments all had equal lengths of dodder used in their experiments. This study will help in understanding the capabilities the dodder plant has of reconstituting itself after being broken or browsed and may help in the eradication of this plant in areas where it is invasive. This experiment questions whether or not there is any plausibility in cutting dotter as a population control method. It will also answer the question of whether various indigenous vegetation are more suited to combat the spread of dodder, which can then be used where ecological restoration efforts are being made. There are several null hypotheses that can be made for each set of this experiment. The 15cm or the 25cm dodder all grew the same length and produced similar number of haustoria. The dodder that attached to each plant grew the same length and produced similar number of haustoria. There were no observable results in the interaction between species and lengths of clipped dodder.

Methods and Materials

Preferential parasitic choice was tested using several different host organisms. These potted plants were chosen because of their significant presence in a variety of different prairie environments and include Butterfly Milkweed, Mist Flower, Prairie Aster, and Rattlesnake Master. Three of each host plant were used in each replicate of this experiment. Dodder plants were chosen from the west edge of the South Prairie at the Litzsinger Road Ecology Center. These plants were already parasitizing a variety of prairie vegetation when they were chosen for the experiment. Growing shoots of the dodder plant were cut at 15cm and 25cm and the clipped end was placed in a glass test tube filled with water. Each test tube with different lengths of dodder were tied with yarn to the side of each potted plants mentioned above so that every host plant species had a different length of dodder attached to it. Once the test tubes were attached to the side of the pot the dodder was tied, 5cm from the growing tip, onto the hosts stem with yarn. All of the host plants with attached dodder were taken down to the edge of the South Prairie at the Litzsinger Road Ecology Center were the dodder clippings were originally taken from. In a random orientation the potted plants were placed near the edge of the prairie. Growing tips from the dodder where clippings had been taken before were then attached, in a likewise manner, to the four species of host plants mentioned above to serve as the control for this experiment. All of the host and dodder plants were left by the edge of the prairie for 108-120 hours to observe how dodder reacted to each host. The host plants were watered several times during this period as well as refilling the water in dodder test tubes. After the allotted time period the length of coiled dodder was measured as well as the haustoria that the dodder produced on each host plant.

Results

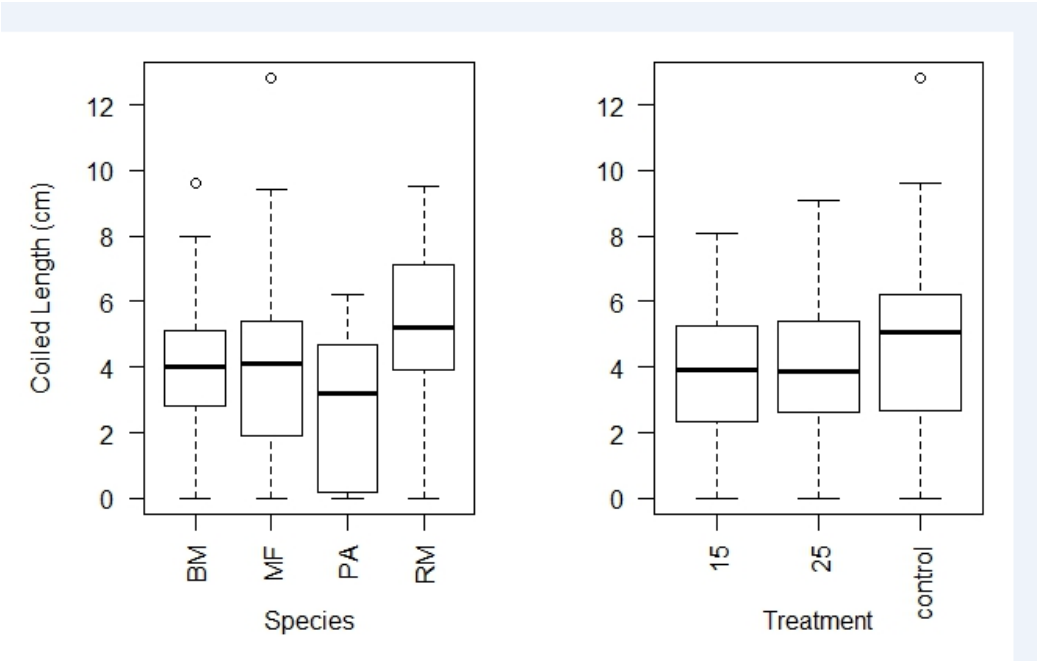

Figure 1) The dodders total coiled length for the combined length treatment on each species is displayed on the left. The coiled length for all species at the treatment lengths used in the experiment is displayed on the right. The highest median coiled length appeared on the rattlesnake master in the left figure and in the control group for the treatment in the right figure.

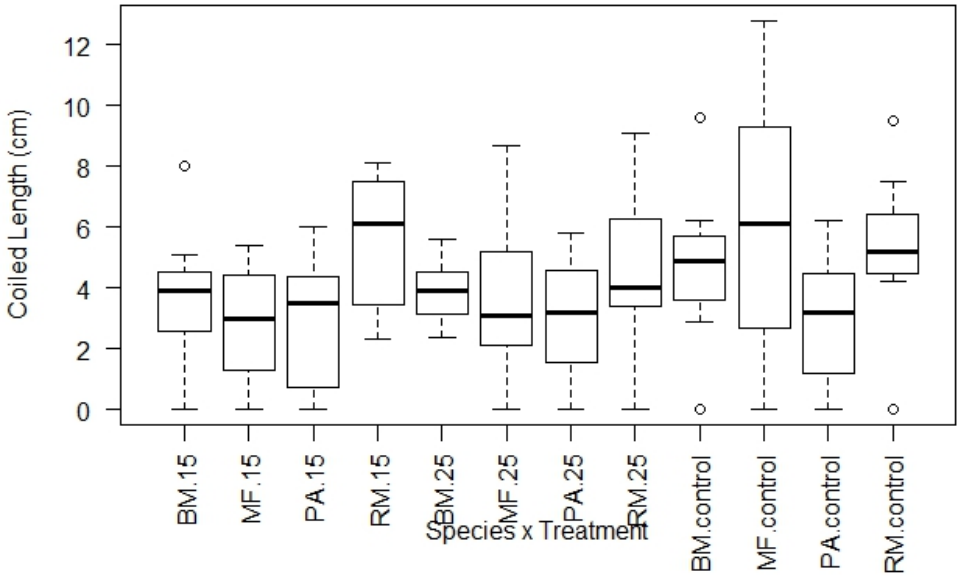

Figure 2) Box-and-whisker plots display the coiled length for each treatment on each species. In both the 15cm and 25cm treatment rattlesnake master has a higher median coiled length than any other species. In the controlled treatment the mist flower has the highest median and the largest overall range compared to all other treatments and species.

```
> dodder1.aov<-aov(Coil.length.cm~Sp*Length.cm+Er
ror(Replicate), data=dodder)
> summary(dodder1.aov)

Error: Replicate
          Df Sum Sq Mean Sq F value Pr(>F)
Residuals  1  9.003   9.003

Error: Within
             Df Sum Sq Mean Sq F value Pr(>F)
Sp            3   50.0  16.652   2.180  0.098 .
Length.cm     2   18.2   9.122   1.194  0.309
Sp:Length.cm  6   28.7   4.788   0.627  0.708
Residuals    71  542.4   7.640
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05
‘.’ 0.1 ‘ ’ 1
```

Table 1) There is slight significance in the species coiled length of dodder as expressed with the P-value of .098. Treatment length from the collection of host plants did not show any significance with a p-value of .309 and the coiled lengths for individual species had no significance with a p-value of .708

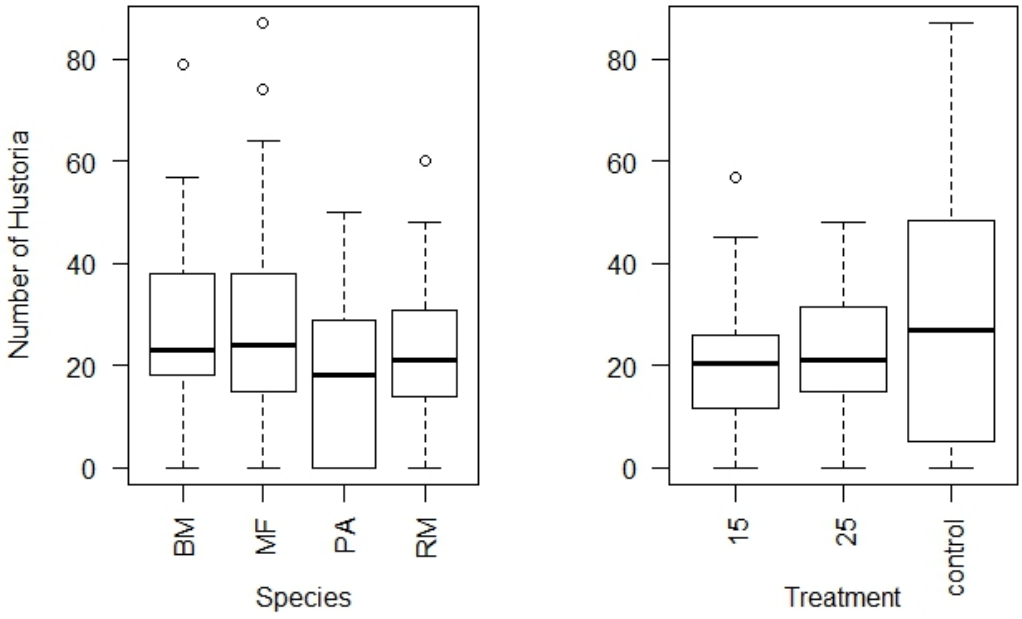

Figure 3) The dodders total number of haustoria produced on each species is displayed on the left. The number of haustoria for each treatment length is displayed on the right. The control group had the highest median of haustoria production as well as the largest range compared to the other two lengths. All four species of hosts had similar median haustoria production and similar ranges.

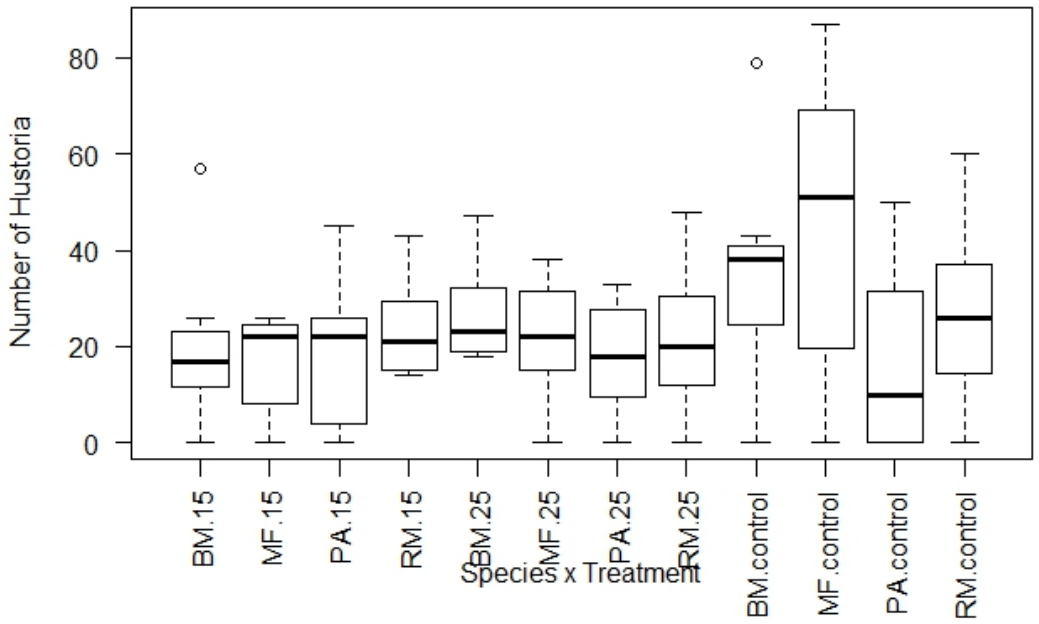

Figure 4) Box-and-whisker plots display the number of haustoria produced for each treatment on each species. In all of the treatment lengths of dodder the median value is similar for all species. In the controlled treatment the mist flower has the highest median and the largest overall range compared to all other treatments and species.

```
> dodder2.aov<-aov(Hustoria~Sp*Length.cm+Error(Re
plicate), data=dodder)
> summary(dodder2.aov)

Error: Replicate
          Df Sum Sq Mean Sq F value Pr(>F)
Residuals  1  502.7   502.7

Error: Within
             Df Sum Sq Mean Sq F value Pr(>F)
Sp            3   1348   449.2   1.286 0.2859
Length.cm     2   2086  1042.8   2.985 0.0569 .
Sp:Length.cm  6   2069   344.8   0.987 0.4406
Residuals    71  24804   349.4
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05
‘.’ 0.1 ‘ ’ 1
```

Table 2) There is no significance in the haustoria that the dodder produces from one species to the next and is expressed with a P-value of .2859. A significant result was found in haustoria production at different treatment lengths with a p-value of .0569. The individual species and their treatment lengths did not have any significance with a p-value of .4406.

Results

When analyzing the outcomes of this experiment the coiled length for the different host species showed some significant results (Table 1). Rattlesnake master plants had a higher median coiled length than any other species in the experiment (Figure 1). This shows us that dodder will coil around rattlesnake master, or preferentially choose to parasitize it, over the other three species of host plants in this experiment. Interestingly the coiled median lengths for all of the species of host plants, besides rattlesnake master, stayed nearly the same between the two cut treatment lengths of 15cm and 25cm (Figure 2). Rattlesnake master also had a much higher median coiled length at 15cm than it did at 25cm (Figure 1). This could be because at a length of 15cm the dodder plant has less resources available to itself than it does at 25cm and since rattlesnake master is a preferred host it does not wish to search or analyze airborne volatile compound cues but wishes to attach itself as soon as possible in order to survive.

Haustoria production in the dodder plants were also analyzed and shown to have some significant results (Table 2). When analyzing the treatment lengths of dodder and the number of haustoria that the plant created we can see that both 15cm and 25cm produced similar amounts of haustoria. The control, however, produced an extremely large amount of haustoria compared to the other two lengths. This may be due to the resource cost associated with the production of haustoria and only a well-established dodder plant has the resources capable of producing haustoria in that amount (Figure 3). When looking at the number of haustoria that dodder created on each species of plants we can also see that they all have a relatively similar range and median and did not produce any significantly different amounts of haustoria based on clipping size (Figure 4).