Allelopathy Experiment

Nate and Glennon

Introduction:

One of the biggest impacts on the production of crops is the weeds that compete with them. It is estimated that crop yield losses due to weeds can be higher than 30% for some types of crops (Jabran et al., 2015). Since current weed control methods of hand weeding, mechanical weeding, and chemical and herbicide application are ineffective, costly, and/or have negative environmental and health impacts, it is important to look for alternative weed control measures. There are secondary metabolites, allelopathic chemicals, found in a variety of plants that can inhibit the growth of competitors and is one possible weed control alternative. Not only would using these plant based compounds be better for the environment and our health but it would also reduce issues of herbicide resistance as new compounds would be used on fields that weeds have not had the chance to adapt to. This natural weed control would also enhance the productivity of organic farms that cannot use manufactured herbicides while reducing that labor cost that would be associated with other weed control methods.

The allelopathic plant that we investigated was *Pisum sativum*. Both the seeds and shoots have been established to have allelopathic effects. Abdul-Rahman et al. (1989) tested the seeds by applying powder of the seeds in differing amounts to the surface soil of pots that contained wheat (crop) and chard and canary grass (weeds) in greenhouse conditions. They also compared the time of application relative to the sowing of the wheat and weed seeds, with two groups of a week before and at the time of sowing. They measured photosynthetic pigments in the wheat as well as measurements for yield in addition to the suppression of weeds. The greatest suppression was found in the highest treatment, 100 g. They also found that the one week before sowing significantly improved suppression. They found the ideal amount for photosynthetic pigments of wheat to be 80 g. For the yield of wheat, the best amount was again the highest, 100 g.

Marles et al. (2010) also looked at field pea seeds but did so in both a greenhouse and in the field. They had found that farmers who stored their field pea seeds from bin clearing over winter in fields had weed inhibition in that spot the following season(s). They used soil from these storage spaces to perform their experiment in a greenhouse to test the weed suppression and crop yield. They used green foxtail as their weed and field peas, wheat, and canola as their crop seeds. They did find that the storage soil did inhibit the weed growth.

Kato-Noguchi (2003) did a chemical analysis and extraction of the chemical pisatin found in the shoots of field plants. They found that this chemical did have an allelopathic effect on cress and lettuce with concentrations of 10 and 30 μM respectively.

Methods:

Field pea plants were grown in a greenhouse for their shoots for three weeks. After being harvested they were dried for one week. Field pea seeds were ground finely with a mortar and

pestle. 10% leachate was prepared from each type of matter by soaking 10 g of plant matter in 100 mL of water for 2 hours and then vacuum filtrating. These leachates were stored in a freezer until use.

The three treatments for this experiment were the shoot leachate, seed leachate, and the control of deionized water. In each treatment 30 radish seeds were soaked for one hour. For each treatment three petri dishes were prepared by adding 25 g of sand to each dish, leveling the sand, and then placing a filter paper on top. Each dish had 10 mL of the treatment added to it and each dish received ten of the radish seeds after they were soaked. The seeds were then covered with a second filter paper that was saturated with the treatment. Petri dishes were then sealed with para film. All dishes were put into a fridge until data collection after three days or until germination.

Root and shoot length were measured for each seed and the germination rate of each dish was recorded. Statistical analysis was done in JMP 15 and a one-way ANOVA was performed.

Results:

The data shows that the radish seeds germinated in the field pea seed leachate had shorter roots and shoots than the control. The leaf leachate caused only one seed to germinate with a shorter root than the seeds in the seed leachate and the control. All three treatments were significantly different from each other (**Figure 1**).

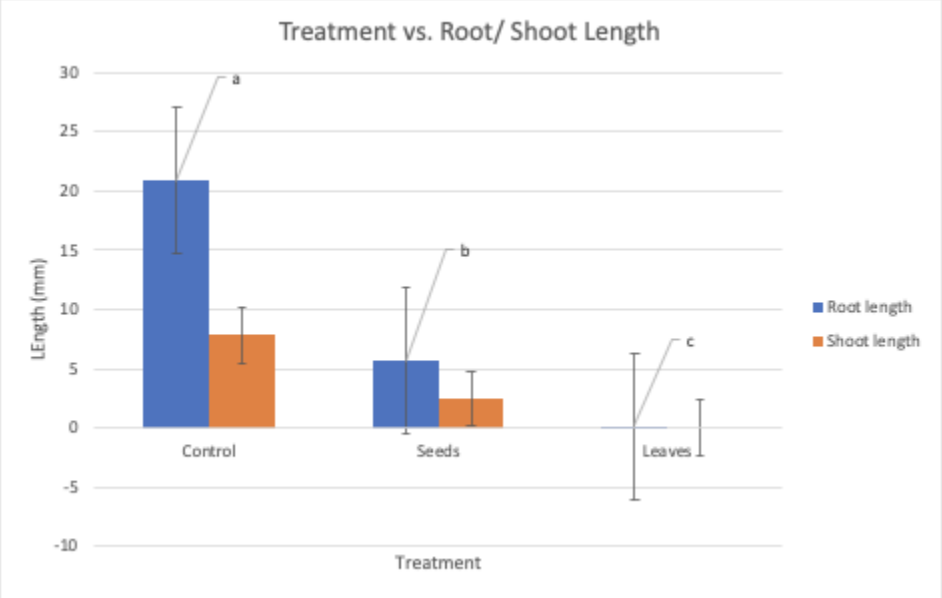

Figure 1 is showing the average root length (blue) and average shoot length (orange) for each treatment at the time of data collection. Significantly different groups are indicated by a, b or c.

We also recorded the percentage of seed that germinated for each treatment. The germination rate of the control group was 96.67%, the seed leachate had a lower germination rate of 66.67%, and the leaf leachate group had the lowest germination rate of 3.33%. The germination rates of the control and the seed leachate groups were significantly different from the germination rate of the leaf leachate, but not from each other.

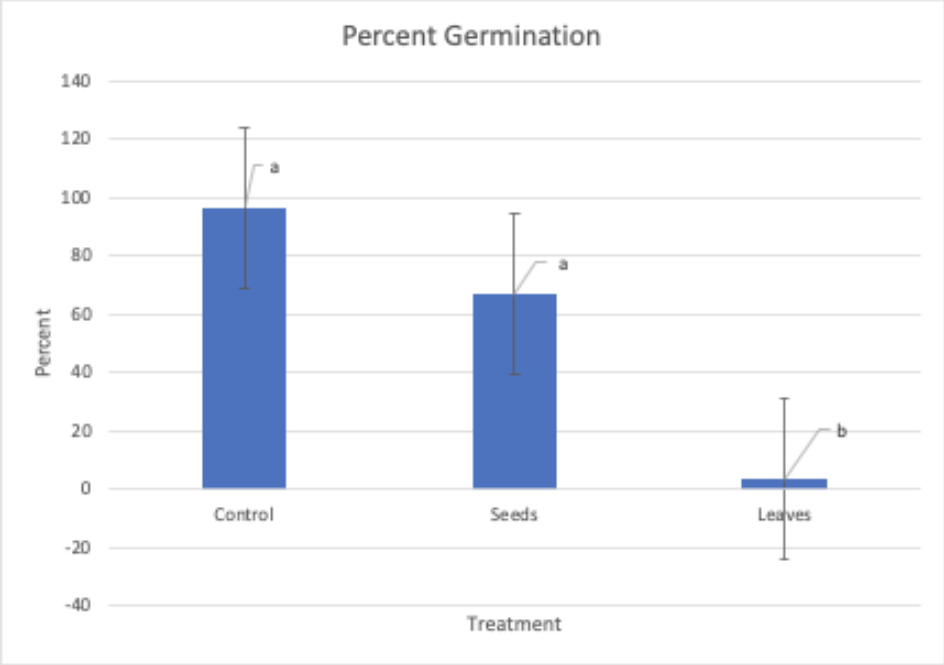

Figure 2 is showing the germination rates of the seeds for each treatment. Significantly different groups are indicated by a or b.

Discussion:

Our experiment only looked at the inhibition of weed seeds and their initial growth in the short timespan of three days in a petri dish while the two studies grew both weeds and crops plants in soil to see not only the effect on weed growth but how the treatment affected crops. Neither of the studies prepared leachates as we did, there was just a form of field peas on the surface of soil that put the allelopathic chemicals into the soil. While we did not perform any chemical analysis the study that did, gave a concentration of the chemical they found to be 32.7 nmol g^{-1} fresh weight in the shoots of field peas. While they used the extracted chemical, they did have a similar method of testing the weed seeds in petri dishes like we did.

Sources:

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