ABSTRACT

During this study, we will investigate how the seed coat can affect the germination process of different seeds. Seed coats exist primarily to keep the seed dormant so growth can take place under the best conditions. If removing the seed coat before planting important agricultural crops such as soybeans can increase rates of germination, the world population can be more easily sustained. To determine the effect of seed coat on germination, we gather six groups of three to four people that choose a species of plant whose seed germinates quickly (3-7 days). Each group will have three types of seeds - one nicked, one with seed coat removed, and one normal seed. Groups will grow each type of seed in its own petri dish, and record observations daily in a spreadsheet. The results of this experiment have important agricultural implications. If lack of seed coat produces a crop that can germinate faster than normal while retaining that same quality, new methods of farming can be introduced to improve agricultural yield.

SPECIFIC AIMS

This study is designed to test how seed coats affect germination. Specifically, the study will address if a seed will germinate better when seed coat is removed, if the seed coat is nicked, or with an in-tact seed coat. Findings of this study can impact agricultural practices, and are analyzed with agriculture in mind.

BACKGROUND

During seed development the inner epidermis cells are still present at the end of development, even though other layers of the seed are removed at earlier stages (BARROS-GALVÃO, VAISTIJ, GRAHAM, 2019). There is an association with the seed coat and keeping seeds in a dormant state due to lack of oxygen permeability through the seed coat (Edwards, 1968). Knowing this information may help increase the rate at which agricultural communities can germinate seeds. This would in turn help increase food availability and profit for agricultural communities.

The idea in question is whether or not the seed coat

inhibits the start of germination on all species of seeds of just select species. If the seed coat inhibits the germination of seeds can this be used for agricultural purposes? It has been shown that seed coat removal of *Prunus* species has shown to increase the breeding efficiency of these species (Szymajda, Żurawicz, Maciorowski, Pruski, 2019). In addition to the lack of oxygen getting through the seed coat, there is a lack of water getting through as well. This is also an inhibiting factor of the seed coat during dormancy (Szymajda, Żurawicz, Maciorowski, Pruski, 2019). This may be another reason why removal of the seed coat or alteration of the seed coat may increase rate of germination.

Since soybeans are globally a valuable crop, there would be interest in understanding soybean variety germination rates and increasing them (Wijewardana, Reddy, Krutz, Gao,Bellaloui,2019). Soybeans in take approximately 2 days to start germinating. With removal, or partial removal of the seed coat, can we increase the time it takes for the seeds to start to germinate? To determine this we have designed an experiment that involves removal of the seed coat and nicking of the seed coat to validate if these processes increase seed germination times.

RESEARCH DESIGN

In order to determine if seeds germinate faster with the seed coat removed six species of seeds will have their seed coat removed. This will be compared to seeds of the same species that do not have the coat removed, and seeds that have had their seed coat knicked. Researchers will be divided into six groups of three to four people. Each group will choose a species of plant whose seeds germinate within 6 to 10 days. The following methods will be followed uniformly by each group, the only differing variable being that of the selected species.

Treatment:

Each group will have a total of 30 seeds that will be divided into collections of 10 seeds that undergo varying conditions. One set of 10 seeds will act as the control, undergoing no treatment; no seed coat removal. The second set of 10 seeds will be nicked with a 25 gauge needle. Nicking will be performed in non-dormant seeds after 1 hour of imbibition using a needle to puncture the chalazal region in order to create a continuum between the embryo and external medium. We will remove the seed coat of the last set of 10 seeds by methods that will be determined based on species of the seed.

Germination:

Each group will receive 3 petri dishes to create germination chambers. We will insert damp paper towels into the petri dishes in order to provide a water source for the germinating seeds. Each of the three treated groups of seeds will be placed into individual petri dishes. We will leave the petri dishes in an incubator located in the ISB with set to consistent conditions.

Collecting Data:

Twice a day, the appearance of each seed in every dish should be noted in an excel spreadsheet. The first column of the excel spreadsheet will be titled date/time so that the time and date of each visit will be recorded. In the next column will be labeled “# of germinated seeds for no seed coat”. The following column will be labeled “# of germinated seeds for with nick”. Then finally the fourth will be named # of germinated seeds for full seed coat”. During a visit an individual will record the number of total germinated seeds in each dish. A fifth column will be added for general observations or inconsistencies.

IMPACT/SIGNIFICANCE

Performing this experiment could benefit farmers and society from an agricultural standpoint. If the results turn out as predicted and seeds with no seed coat germinate faster, this could lead to a new way of farming and sustainability in agriculture. Faster germination would mean more crop production throughout the year which would have benefits environmentally and economically. If the results do not turn out as predicted, i.e. the seeds fail to germinate or it has no effect on germination rates, this will help us understand crop production further to make better decisions in the future. We could then conclude if the seed coat is or is not important for success rates of plants and crops, and use this information to our advantage in the future of agriculture.

REFERENCES:

BARROS-GALVÃO, T.; VAISTIJ, F. E.; GRAHAM, I. A. Control of seed coat rupture by ABA-INSENSITIVE 5 in Arabidopsis thaliana. Seed Science Research, [s. l.], v. 29, n. 2, p. 143–148, 2019. Disponível em: <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=137544057&site=ehost-live&scope=site>. Acesso em: 25 out. 2019.

Edwards MM (1968) Dormancy in seeds of Charlock: III. Occurrence and mode of action of an inhibitor associated with dormancy. Journal of Experimental Botany 19, 601–610.

Szymajda, M., Żurawicz, E., Maciorowski, R., & Pruski, K. (2019). Stratification period combined with mechanical treatments increase Prunus persica and Prunus armeniaca seed germination. Dendrobiology, 81, 47–57. https://doi-org.silk.library.umass.edu/10.12657/denbio.081.006

Wijewardana, C., Reddy, K. R., Krutz, L. J., Gao, W., & Bellaloui, N. (2019). Drought stress has transgenerational effects on soybean seed germination and seedling vigor. PLoS ONE, 14(9), 1–20. https://doi-org.silk.library.umass.edu/10.1371/journal.pone.0214977