# NATIONAL FFA AGRISCIENCE FAIR

YOUR RESOURCE FOR WRITING A POWERFUL MANUSCRIPT

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Thank you,

National FFA Agriscience Fair Committee and Program Staff

*Revised: February 7, 2022*

# ABSTRACT - 3 POINTS POSSIBLE

## OVERVIEW

- **Describes purpose, methods, results and conclusion.**
- **Should not contain any cited references.**
- **Is no longer than one page.**
- **Arranged so that the purpose, methods, results and conclusions are clear.**

## EXAMPLE 1:

*The purpose of the study is identified.*

Like most flowering plants, strawberries can engage in both sexual and asexual reproduction methods. However, due to poor germination rates, strawberry seeds are often not considered a viable option by commercial producers. Instead, plant runners and cuttings through asexual reproduction are more common. However, altering environmental settings such as moisture, chemical contact, and temperature can increase seed germination rate. The **purpose** of the current study was to determine if strawberry seed germination rate would increase when treated with any of the following chemicals: gibberellic acid, sulfuric acid and ethylene.

*A brief narrative of the methods and procedures were explained.*

The experimenters began the project by splitting seeds into four groups of 75 strawberry seeds. Each group of seeds were placed in a wet plastic bag that had been treated with one of the following chemicals: gibberellic acid, sulfuric acid, ethylene, and an untreated control group. After an exposure time of 24-hours, the seeds were washed and transferred to another sealed bag with only water. Next, the seeds were placed in 128-plug trays filled with potting soil. The trial period lasted 30 days with germination rates recorded every five days. The **hypothesis** was that if strawberry seeds were treated with various chemicals, then the seeds treated with ethylene would have a significantly greater germination rate ($p$-value $\leq 0.05$) than other chemicals because it is the most effective form of chemical scarification.

*The results and conclusion are clear and concise.*

In looking at the **results**, the control group had a significantly lower germination rate of 17.33 percent while gibberellic acid had the highest germination rate of 80 percent. However, all three chemicals had similar germination rates. In **conclusion**, the experimental hypothesis was rejected as all three chemicals proved to be viable sources of chemical scarification. Moving forward, an additional study was recommended to determine ideal chemical quantity treated.

## EXAMPLE 2:

Like most flowering plants, strawberries can engage in both sexual and asexual reproduction methods. However, due to poor germination rates, strawberry seeds are often not considered a viable option by commercial producers. Instead, plant runners and cuttings through asexual reproduction are more common. However, altering environmental settings such as moisture, chemical contact, and temperature can increase seed germination rate. The purpose of the current study was to determine if strawberry seed germination rate would increase when treated with chemicals.

The project began by splitting seeds into four groups. Each group was placed in a wet plastic bag that had been treated with one of the chemicals and a control group. After an exposure time the seeds were washed and transferred to another bag with only water. Next, the seeds were placed in trays filled with potting soil. The hypothesis was that if strawberry seeds were treated with various chemicals, then the seeds treated with ethylene would have a significantly greater germination rate than other chemicals.

The control group had a significantly lower germination rate. In conclusion, the experimental hypothesis was rejected.

### EXAMPLE 3:

The purpose of the current study was to determine if strawberry seed germination rate would increase when treated with chemicals.

The project began by splitting seeds into four groups. Each group was placed in a bag that had been treated with a chemical and a control group. After some time, the seeds were washed and transferred to another bag with only water. Next, the seeds were placed in trays filled with potting soil. The hypothesis was that if strawberry seeds were treated with various chemicals, then the seeds treated with the chemical would have a significantly greater germination rate than other chemicals.

The control group had a significantly lower germination rate. In conclusion, the experimental hypothesis was rejected.

# INTRODUCTION - 10 POINTS POSSIBLE

## OVERVIEW

**Why was the work done?**

- **Clearly states the problem.**
- **Justifies why the research was done.**
- **What was the purpose of the research?**
- **What is the impact on agriculture?**
- **Explains findings from earlier work.**
- **Explains the general approach to the objectives.**

### EXAMPLE 1:

*This paragraph identifies the problem for the reader.*

Like most flowering plants, strawberries can engage in both sexual and asexual reproduction methods (Source, 2017). Strawberry producers typically only rely on sexual reproduction to collect fruit as a food source while asexual reproduction results in clones that provide identical replacements (Source, 2017). As the only fruit that contains seeds on the outside of the fruit, a single strawberry can contain 300 seeds (Source, 2011). However, these seeds are often difficult to germinate with untreated seeds often taking over 30 days to sprout; by altering factors such as moisture exposure and temperature, some varieties of strawberry seeds can sprout in as little as four days (Source, 2011). As a result, most commercial growers rely on plant clippings or runners for reproduction rather than strawberry seeds (Source, 2017).

*This paragraph tells the reader the purpose and the impact on agriculture and justifies why the research was done.*

The current work was conducted to determine which type of chemical treatment will best allow for higher and faster germination rates in strawberry seeds of the G-variety. The use of chemicals to increase gemination rate is known as scarification; by scarifying seeds, the seed coat is weakened, allowing water to enter the seed and induce germination (Source, 2017). This study addresses the current problem of poor germination rates seen in many strawberry varieties grown by commercial producers as well as home growers. The **purpose** of the research is to increase the low strawberry germination rate from seed to increase the potential of raising strawberry plants through sexual reproduction. This provides a positive **impact to the agricultural industry** by increasing options for strawberry production. In addition, by reducing time to germination, strawberry plants will reach maturity and fruit production at a faster rate.

*This paragraph tells the reader about findings from earlier work and explains the general approach of the research.*

In looking at the **findings of earlier work**, a foundational study was conducted by Lata et al. (2018) in which they found the lowest germination rate in untreated strawberry seeds of 19 percent. However, by treating seeds with ethylene, the germination rate increased to 86 percent and seeds treated with gibberellic acid had a similar rate of 84.33 percent. This indicates that chemical treatment can assist strawberry seeds in breaking dormancy. The general approach of the current research was to replicate the study by Lata et al. (2018) with the objective of discovering methods of increasing germination rate.

### EXAMPLE 2:

The current work was conducted to determine which type of chemical treatment will best allow for higher and faster germination rates in strawberry seeds. The use of chemicals to increase gemination rate is known as scarification; by scarifying seeds, the seed coat is weakened, allowing water to enter the seed and induce germination (Charlotte, 2017). This study addresses the current problem of poor germination rates seen in many strawberry varieties. The purpose of the research is to increase strawberry germination rate from seed to increase the potential of raising strawberry plants. This provides a positive impact to the agricultural industry by increasing options for strawberry production.

In looking at the findings of earlier work, a study was conducted by Lata et al. (2018) in which they found the lowest germination rate in untreated strawberry seeds of 19 percent. The general approach of the current research was to replicate the study by Lata et al. (2018).

### EXAMPLE 3:

The current work was conducted to determine which type of chemical treatment will best allow for higher and faster germination rates in strawberry seeds. The use of chemicals to increase gemination rate is known as scarification; by scarifying seeds, the seed coat is weakened, allowing water to enter the seed and induce germination (Charlotte, 2017). This study addresses the current problem of poor germination rates seen in many strawberry varieties. The purpose of the research is to increase strawberry germination rate from seed to increase the potential of raising strawberry plants. This provides a positive impact to the agricultural industry by increasing options for strawberry production.

## LITERATURE REVIEW - 10 POINTS POSSIBLE

### OVERVIEW

- **What information currently exists about this topic?**
- **What materials were used for this research?**
- **Cited articles about similar studies, research methods, history of the research area and other items support the current researcher's knowledge about the topic.**
- **How does the project complement or supplement existing information?**

### EXAMPLE 1:

*The researcher broke down their current project to determine what aspects of their research had previous information available. The first item the researchers identified was the use of different chemicals that aid in seed germination. All articles and studies were cited.*

In looking at chemical use, ethylene can regulate several plant processes such as seed germination and seedling establishment (Source, 2014). Ethylene can impact the hormonal balance which impacts the time in which the radicle passes through the seed coat and has quickened germination time in cotton, pea, and sunflower seeds (Source, 2014). The second chemical, gibberellic acid, can be used to overcome dormancy, increase fruit production, and prevent root growth on cuttings (Source, 2018). Gibberellic acid expose for a short time can be used as a pre-treatment to speed up germination time in some plants while having no impact on other plants (Source, 2018). Using a dosage too high can kill the seeds or cause seedlings to grow too fast and become weak (Source, 2018). The final chemical used, sulfuric acid, can increase germination rate through promoting water absorption rate in seeds (Source, 2012).

*The researcher found similar studies using different methodologies but could apply the same concepts to their project. The research outlined the materials used, research method and other items that helped support their knowledge about their topic.*

The foundational study for the current research was conducted by Lata et al. (2018) and published in the International Journal of Current Microbiology and Applied Sciences. In this project, harvested seeds were washed and stored for 50 days which allowed the embryos to mature. Next the seeds were soaked for 24 hours in the chemical followed by 24 hours in water; the seeds were kept at room temperature for the duration of the treatment procedure. After planting seeds, germination rates were measured every five days between planting and 30 days. At the end of the trial, the control group, treated with solely water had a 19 percent germination rate after 30 days. In comparing treatment groups, the high quantity Ethrel (5000 ppm) had the highest germination rate of 86 percent and the lower quantity

Ethrel (1000 ppm) had a germination rate of 80.67 percent. For gibberellic acid (GA3), the high quality GA3 (200 ppm) had a germination rate of 84.33 percent while lower quantity GA3 (100 ppm) had a 30-day germination rate of 71.33 percent.

Another similar study was conducted by Gavlao et al. (2014) in which strawberry seeds were immersed in sulfuric acid (98 percent), hydrochloric acid (37 percent) and sodium hypochlorite (two percent) for the following minutes: 0, 10, 20, 40, and 50 minutes. While untreated seeds had a minimal germination rate below 10 percent, seeds treated with sulfuric acid for 40 minutes had the highest germination rate of 80 percent after 40 minutes of treatment. On the other hand, all treatments of hydrochloric acid and sodium hypochlorite resulted in minimal improvement in germination rate with all experimental groups below 20 percent. This allowed the experimenters to recommend sulfuric acid as a suitable chemical for breaking strawberry seed dormancy while discouraging the use of the other two chemicals on strawberry seeds.

### EXAMPLE 2:

In looking at chemical use, ethylene can regulate several plant processes such as seed germination and seedling establishment (Corbineau, 2014). The second chemical, gibberellic acid, can be used to overcome dormancy, increase fruit production, and prevent root growth on cuttings (Pavlis, 2018). Gibberellic acid expose for a short time can be used as a pre-treatment to speed up germination time in some plants while having no impact on other plants (Pavlis, 2018). Using a dosage too high can kill the seeds or cause seedlings to grow too fast and become weak (Pavlis, 2018). The final chemical used, sulfuric acid, can increase germination rate through promoting water absorption rate in seeds (Wang et al., 2012).

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## MATERIALS AND METHODS - 15 POINTS POSSIBLE

### OVERVIEW

- **Is it written so someone else could replicate?**
- **Is it written in the third person?**
- **What materials were used?**
- **Was the hypothesis restated?**
- **Was the research question(s) clearly stated?**
- **Was the study design clearly explained?**
- **What were the statistical procedures, if used?**

## EXAMPLE 1:

*In this paragraph, the writer told the reader what materials were needed/used and the dependent and independent variables.*

In acquiring materials to conduct the current project, researchers collected the following chemicals to use: X-Floral 16-ounce container, G acid 90% 12- gram packet, and Thomas Acid 60 mL bottle. Each container contained a different chemical used in scarification: Ethylene, Sulfuric Acid, and Gibberellic Acid. Other materials used for this project were a 500-seed packet of Strawberries, eight sealable sandwich bags, a roll of paper towels, four plug starter trays, a bag of potting soil, and an artificial lighting grow cart. For this project, the **independent variable** was the type of chemical used to induce germination while the dependent variable was the seed germination rate. The **control group**, for comparison, was the group of seeds that remained untreated by chemicals.

*In these paragraphs, the writer tells the reader the steps taken to complete their experiment so that the reader can replicate the study.*

The experimenters began the project by separating the seeds into four groups with 75 seeds each. Paper towels were soaked in water and treated with the following: Ethylene, Sulfuric Acid, Gibberellic Acid, and solely water. Next, 75 seeds were placed on each paper towel and deposited into a sealed plastic bag. The seeds remained in the bag for a 24-hour period. Afterwards, the seeds were removed from the plastic bag, taken off the paper towel, and washed to remove any chemical residue. The seeds were then placed on wet paper towels and placed in a different plastic bag for another 24-hour time period with only contact to water.

After the second 24-hour soaking period, the seeds were removed from a plastic bag. Four 128-plug trays were filled with potting soil and labelled with the following descriptions: Ethylene, Sulfuric Acid, Gibberellic Acid, and Control Group. For each tray, a seed was placed in 75 of the plugs by placing them on the soil surface and then lightly covered with soil. Once the four trays were filled with soil, they were placed under the artificial lighting of the growth cart.

*In the final paragraph of the materials and methods section, the writer tells the reader the statistical procedure and restates the hypothesis.*

The trial period lasted for 30 days. Due to the small size of the plug holes, the trays were watered every day. After time periods of 10, 20, and 30 days, the number of sprouts were counted for each tray and divided by 75 to determine the germination rate. This data was inputting into Microsoft Excel to determine the average germination rate and then to conduct a test as the primary form of **statistical analysis.** A t-test provides a p-value between zero and one with lower number indicators stronger data. For this project, a p-value at or below 0.05 was considered statistically significant with a confidence level of 95 percent. The **experimental hypothesis** was that if strawberry seeds were treated with various chemicals, then the seeds treated with ethylene would have a significantly greater germination rate (p-value $\leq 0.05$) than other chemicals because it is the most effective form of chemical scarification.

## EXAMPLE 2:

In acquiring materials to conduct the current project, researchers collected the following chemicals to use: Monterey MLGNLG4100 Florel 16-ounce container, Gibberellic acid 90% 12- gram packet, and Thomas SA9555-B Sulfuric Acid 60 mL bottle. Other materials used for this project were Galletta Strawberries, sandwich bags, a roll of paper towels, 128-plug starter trays, potting soil, and an grow lights. For this project, the independent variable was the type of chemical used to induce germination while the dependent variable was the seed germination rate.

We began by separating the seeds into four groups. Paper towels were soaked in water and treated with the following: Ethylene, Sulfuric Acid, Gibberellic Acid, and solely water. Next, 75 seeds were placed on each paper towel and deposited into a sealed plastic bag. The seeds remained in the bag for a 24-hours. The seeds were then removed from the plastic bag, taken off the paper towel, and washed to remove chemical residue. The seeds were then placed on wet paper towels and placed in a different plastic bag for another 24-hours.

The seeds were removed from a plastic bag. The plug trays were then filled with potting soil and labelled with each group. For each tray, a seed was placed in 75 of the plugs by placing them on the soil surface and then lightly covered with soil. Once the trays were filled with soil, they were placed under the artificial lighting of the growth cart.

The trial period lasted for 30 days. Due to the small size of the plug holes, the trays were watered every day. After time periods of 10, 20, and 30 days, the number of sprouts were counted for each tray and divided by 75 to determine the germination rate. This data was inputting into Microsoft Excel to determine the average germination rate and then to conduct a t- test as the primary form of statistical analysis. The experimental hypothesis was that if Galletta strawberry seeds were treated with various chemicals, then the seeds treated with ethylene would have a significantly greater germination rate than other chemicals because it is the most effective form of chemical scarification.

## EXAMPLE 3:

Materials:

- Monterey Florel 16-ounce Container
- Gibberellic Acid
- Thomas Sulfuric Acid
- Strawberries
- Bags
- Paper Towel
- Plug Trays
- Potting Soil
- Grow Light

Methods:

1. Wash strawberries to remove any residue chemicals.
2. Separate strawberries into 4 groups.
3. Soak paper towels in the 3 different types of chemicals and 1 paper towel in water.
4. Place 75 seeds on each paper towel.
5. Put seeds and paper towels into sealed plastic bag.
6. Leave seeds in bag for 24 hours.
7. After 24 hours remove seeds and wash any remaining chemicals off.
8. Place clean seeds on a wet paper towel and place in a clean bag for 24 hours.
9. Remove seeds after 24 hours.
10. Fill plug trays with potting soil.
11. Place 1 seed in each plug hole. Each tray should have 75 seeds.
12. Lightly cover the seeds with potting soil.
13. Place filled trays under grow lights.

The trial period lasted for 30 days. Due to the small size of the plug holes, the trays were watered every day. After time periods of 10, 20, and 30 days, the number of sprouts were counted for each tray and divided by 75 to determine the germination rate. This data was inputting into Microsoft Excel to determine the average germination rate and then to conduct a t- test as the primary form of statistical analysis. The experimental hypothesis was that if Galletta strawberry seeds were treated with various chemicals, then the seeds treated with ethylene would have a significantly greater germination rate than other chemicals because it is the most effective form of chemical scarification.

# RESULTS - 20 POINTS POSSIBLE

## OVERVIEW

- **Project is summarized.**
- **Trends and relationships are clearly addressed.**
- **No conclusions are made in this section.**
- **Data can stand alone in the form of tables and/or figures.**

*****All figures and graphs have been removed from this example.***

## EXAMPLE 1:

*The research has summarized the collected data, the number of trials, and how long each trial lasted. A table was included with germination percentage taken every five days.*

Figure 1 compares the germination rate of each experimental group over a 30-day trial period. The control group with no treatment began slowly with no seeds sprouting before 10 days post-planting. While the gibberellic acid started off more quickly, all three chemicals displayed similar trends in sprouting rate over the 30-day period.

*Figure 1. Comparison of germination rate over time.*

*Figure 2 shows the trend of each group and summarizes the best and worst performing test group.*

Figure 2 shows the trend in seed germination over five-day increments. A similar trend in growth can be seen among all three chemicals with gibberellic acid and ethylene resulting in the highest germination rate. The control group performed the worst.

*Figure 2. Trends in germination rate over a 30-day trial period.*

*Figure 3 explains the statistical analysis between each t-test group.*

Figure 3 runs statistical analysis between each of the four groups after conducting a t-test to provide a p-value. Prior to conducting this project, a p-value at or below 0.05 was set as the standard for statistical significance. All three chemicals were highly significant compared to the control group. The only comparison that did not result in a significant difference was between gibberellic acid and ethylene.

*Figure 3. Data analysis among groups with p-values*

***All figures and graphs have been removed from this example.*

### EXAMPLE 2:

Figure 1 compares the germination rate of each experimental group over a 30-day trial period.
*Figure 1. Comparison of germination rate over time.*

Figure 2 shows the trend in seed germination over five-day increments.
*Figure 2. Trends in germination rate over a 30-day trial period.*

Figure 3 runs statistical analysis between each of the four groups after conducting a t-test to provide a p-value.
*Figure 3. Data analysis among groups with p-values.*

***All figures and graphs have been removed from this example.*

### EXAMPLE 3:

I had 4 different groups. In the first group I gave the strawberries water every 5 days, the second group had Sulfuric Acid, the third group got Gibberellic Acid, the fourth group had Ethylene. Groups 3 had the highest germination rate with 80% of the seeds germinating by the end. the other groups didn't do as well.

## DISCUSSION AND CONCLUSIONS - 15 POINTS POSSIBLE

### OVERVIEW

- **Brief recap of the results.**
- **Results show how they were the foundation of the study.**
- **Reasoning is shown that conclusions are based on results.**
    - **Incorporates previous literature.**
    - **Relates directly to the hypothesis.**
- **Discussion refers to or references facts and figures in results section.**
- **Provides recommendations for:**
    - **Practice.**
    - **Future research.**
    - **The impact on agriculture.**

### EXAMPLE 1:

*In the paragraphs below, the researcher recaps the results and refers to the figures in the results section. The results show the foundation of the study, and it provides reasoning by incorporating previous literature and relates directly to the hypothesis.*

In reviewing the data, Figures 1 and 2 illustrates a slow germination trend for the control group in which untreated strawberry seeds did not sprout until after 10 days and only reached 17.33 percent after 30 days. In looking at the three types of chemicals utilized in the study, gibberellic started at a much faster rate through the first 20-days. However, the sulfuric acid and ethylene groups increased sprouting rate quickly after 20 days and reached a near-similar germination rates at 30-days. In determining if true significant differences exist between each experimental group, Figure 3 portrays the p-values between each group. With a p-value of 0.0001, each type of chemical performed highly significantly better than the untreated group with a high confidence of 99.99 percent. While gibberellic acid had the highest germination rate of 80 percent, it was not significantly higher than ethylene.

The data, illustrated above, follows the findings of Lata et al. (2018) in which ethylene and gibberellic acid both performed similar and significantly higher than the control group. In both the current study and that of Lata et al. (2018), the control group was similarly low with 17- 19 percent germination rate while the chemical scarification groups were around 80 percent. In addition, the findings follow those of Galvao et al. (2014) in which sulfuric acid presents a viable option for inducing germination in strawberry seeds. Based on the current findings and those of Lata et al. (2018) and Galvao et al. (2014), the researchers reject the experimental hypothesis. While ethylene is proven as a viable chemical for inducing strawberry seed germination it was not proven to be significantly more effective than gibberellic acid.

*In the paragraphs below, the researcher provides recommendations for practice, future research, and the impact on agriculture.*

In looking for recommendations for practice, the experimenters support the use of any of the three chemicals as a means to induce germination in strawberry seeds. One additional factor that growers might look at is cost. Based on prices through Amazon, ethylene cost $16.09, gibberellic acid cost $14.99, and sulfuric acid cost $5.12. While sulfuric acid barely reached the threshold for being significantly less effective than the other two materials (p-values of 0.042 and 0.049), the lower cost of purchase might entice producers to choose it. In looking at the study's impact on agriculture, strawberry producers can utilize sexual reproduction in their operation and increase plant numbers. It also proves to homeowners that simply planting untreated seeds is not a viable method of producing strawberry plants.

*This paragraph states how the researchers might move forward with the information they gathered from this study.*

Moving forward, the plan of study is to further follow the study of Lata et al. (2018) in which different quantities of the same chemical were measured to determine its impact on germination rate. It is the intentions of the experimenters to host follow up studies where different quantities and treatment durations were applied with the same chemicals. As Pavlis (2018) discovered, excessive gibberellic acid expose can be determinantal to seed sprouting and seedling growth. Through these additional studies, a clearer picture will exist on how to use chemicals to induce germination in strawberry seeds.

## EXAMPLE 2:

In reviewing the data, Figures 1 and 2 illustrates a slow germination trend for the control group in which untreated strawberry seeds did not sprout until after 10 days and only reached 17.33 percent after 30 days. However, the sulfuric acid and ethylene groups increased sprouting rate quickly after 20 days and reached a near-similar germination rates at 30-days. In determining if true significant differences exist between each experimental group, Figure 3 portrays the p-values between each group. While gibberellic acid had the highest germination rate of 80 percent, it was not significantly higher than ethylene.

The data follows the findings of Lata et al. (2018) in which ethylene and gibberellic acid both performed similar and significantly higher than the control group. In addition, the findings follow those of Galvao et al. (2014) in which sulfuric acid presents a viable option for inducing germination in strawberry seeds. Based on the current findings and those of Lata et al. (2018) and Galvao et al. (2014), the researchers reject the experimental hypothesis. While ethylene is proven as a viable chemical for inducing strawberry seed germination it was not proven to be significantly more effective than gibberellic acid.

In looking for recommendations for practice, the experimenters support the use of any of the three chemicals as a means to induce germination in strawberry seeds. While sulfuric acid barely reached the threshold for being significantly less effective than the other two materials (p-values of 0.042 and 0.049), the lower cost of purchase might entice producers to choose it.
Moving forward, the plan of study is to further follow the study of Lata et al. (2018) in which different quantities of the same chemical were measured to determine its impact on germination rate. Through additional studies, a clearer picture will exist on how to use chemicals to induce germination in strawberry seeds.

## EXAMPLE 3:

I noticed that the seeds treated with a chemical grew faster than those not treated. This is important to agriculture so that farmers know they should use chemically treated seeds so that they have better germination rates and can produce higher yields.

# ACKNOWLEDGEMENTS, REFERENCES AND APA STYLE/SPELLING - 7 POINTS POSSIBLE

## OVERVIEW

**Acknowledgments:**

- **Detailed list or paragraph acknowledging:**
  - **Anyone who assisted with any aspect of the project.**
  - **How did they help?**

**References:**

- **Contain:**
  - **Significant.**
  - **Published.**
  - **Relevant Resources.**

**Resources to use to check APA references:**

- www.opendemia.com
- www.scribbr.com
- www.easybib.com

## ACKNOWLEDGEMENT EXAMPLE:

First, this project would not be possible without the financial support of our parents: (*Parents names removed)*, for purchasing the three chemicals needed to scarify the strawberry seeds. Next, we would like to thank our junior high agricultural education instructor, *(Teacher's name removed)*, for educating us on the methods of scarification and stratification, guiding us through creating a quality experimental design, and assisting us with understanding the t-test. Finally, we would like to thank the *(School's name removed)* Agricultural Education Department for allowing us to utilize their grow cart as a location to conduct our research during colder months.

## REFERENCE EXAMPLE:

**Should be in alphabetical order and APA format.**

Barker, B. (2017, November 21). Stages of Strawberry Seed Germination. Retrieved from https://homeguides.sfgate.com/stages-strawberry-seed-germination-79865.html.

**The following section is not included in the manuscript but comes from the National FFA Agriscience Fair application.**

# SKILL DEVELOPMENT – 20 POINTS POSSIBLE

## OVERVIEW

- **Five competencies:**
  - **Three from primary pathway.**
  - **Two from other pathway.**
- **Demonstrate skills that are appropriate for the scope of the project.**
- **Demonstrate application of skill attainment with measurable impact on the overall project.**