Team Name: STEAMTroopers
Team #: 13147
Challenge Division: Elementary
Challenge Identifier: Plant the Moon Challenge
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How Do Soybeans Grow in Different Ratios of Lunar Regolith & Illinois Black Soil?

Background:
For our Plant the Moon Challenge, we chose to test different ratios of black soil to lunar regolith. Our school is located in central Illinois, which is known for its prime farmland. The United States is the top producer of soybeans and it is the second largest crop grown in Illinois. Soybeans can be a great food source since they are rich in Vitamin C, Vitamin B6, Vitamin D, iron, and soy protein. When the soybean is still in the green stage, edamame, it can be steamed and eaten in out of the pod. The yellow soybean can be used to make several products such as, soy sauce, soy milk, meso, tofu, and tempeh. Since the soybean has many uses, are high in fiber and protein, are cholesterol free and are grown right around our playground, we thought it would be interesting to see if they would grow in lunar regolith too. We decided to test which ratio of central Illinois's rich black soil mixed with lunar regolith would grow the soybeans the best. We tested fifteen pots of the black soil/regolith mixture using different ratios. We decided to test three pots of each ratio.

Independent Variables:
The independent variables we had were the ratios of lunar regolith to black soil: 100% regolith, 80% regolith to 20% black soil, 60% regolith to 40% black soil, and 50% regolith to 50% black soil. We also planted pots of and 100% black soil, which were our controls to test the soybean validity.

Dependent Variables:
The dependent variables were the height of the soybean plants and the number of leaves that grew. We measured the height of our plants in centimeters Monday, Wednesday, and Friday of each week.

Controls:
- the amount of light and the type of light (grow lights) that each pot was exposed to
- Illinois black soil from the same area was used in each ratio
- the same lunar regolith was used in each ratio
- all pots were grown in the same room
- all pots were tested for 8 weeks and data was recorded for 8 weeks
- one soybean seed was planted in each pot - all seeds were the same variety of FS soybean seeds
- 3 inch pots were used for each ratio mixture

Project Hypothesis or Aim:
We predicted that if a soybean seed was planted in mixtures of lunar regolith and black soil in the following ratios: 100 % regolith, 80% regolith to 20% black soil, 60% regolith to 40% , and 50% regolith to 50% black soil, the best plant growth results would be with the 50% regolith to 50% black soil ratio. We chose the ratio 50% of lunar regolith to 50% of black soil because our research showed that lunar regolith does not have some of the nutrients needed to grow soybeans.. We think the more black soil that can be added, the better the soybeans will grow. We think the rich black soil of Illinois will provide some of the missing nutrients like nitrogen, phosphorus, potassium, sulfur, and iron that is needed to grow soybeans.

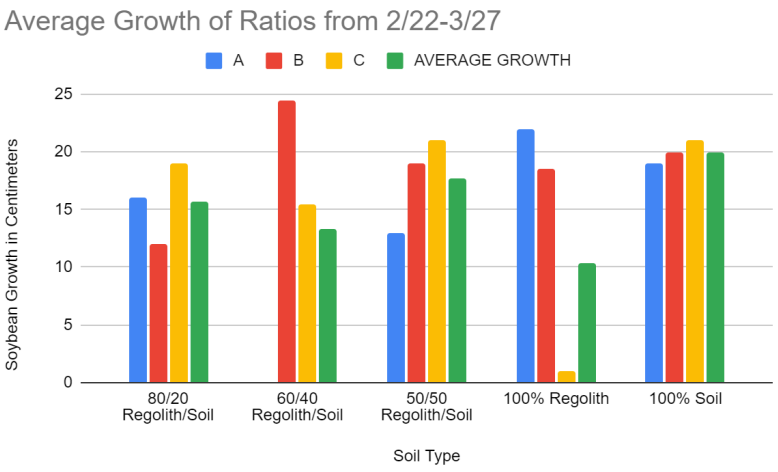
Experimental Design and Procedures:
To test the results of soybean growth in lunar regolith and Illinois black soil ratios, we first mixed the following ratios: 100% regolith, 80% regolith to 20% black soil, 60% regolith to 40% black soil, 50% regolith to 50% black soil. We put the mixture in a 3 inch pot. We made 3 pots of each ratio and label them with A, B, and C. One soybean was then added to each pot. We planted it approximately 3 cm below the surface. Next, we added 2 mL of water to each pot and tested the soil moisture. We continued to add 2mL of water until the soil tested moist enough for planting. We did our first planting on February 22, 2023. In the beginning we added 2mL of water each day. The first two days the soil tested very, very dry. We concluded that 2 mL of water would not be enough. Through further research, we decided to check the moisture each day and use the scale of 15 mL of water when the moisture level tested 4 or less. If the moisture level was 4 or more, we added 10 mL each day. Every Friday we added 15 - 20 mL to each pot to make sure the soil was moist enough for the weekend. We always used water from the same faucet. The pots were observed daily, Monday through Friday. When sprouts developed, we measured them each Wednesday and recorded their growth. We also recorded other notes about their growth including the number of leaves. The data was recorded weekly for eight weeks. Every Wednesday we tested the pH and the temperature of the soil mixture and recorded it. We made a watering schedule and observation schedule. We had two students check the plants each day, along with our teacher. The full team met twice a week to discuss the observations. Our Spring Break was during the growing schedule, so one teacher and one student volunteered to come to school each day to care for our experiment. When they came in on the Monday, March 22, they found the room was very, very hot and the pots were very dry. The plants looked wilted. They placed a fan in the room and left the door open to let some of the hot air escape. Each pot was given 15mL of water and they continued to give them 15mL each day for the rest of the week. The next Monday, March 27th, when we came back from Spring Break, all our plants were dead. We decided to replant every pot by reusing the same soil mixtures with one soybean seed.

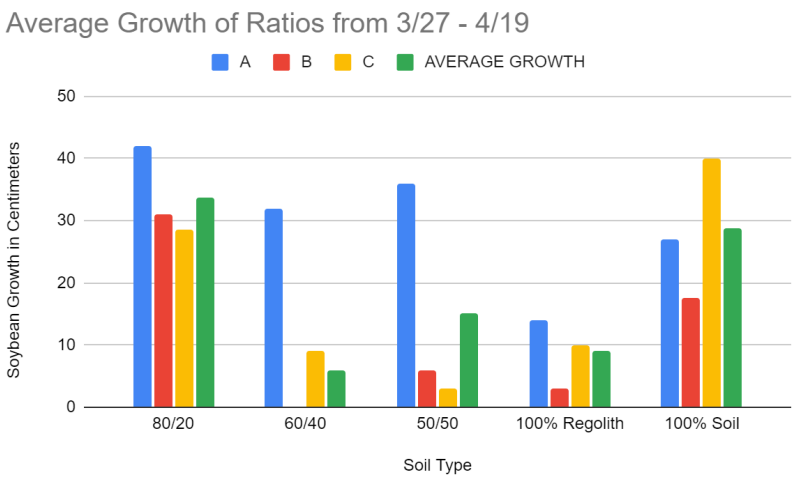
Conclusion:
In conclusion, when we planted one soybean seed in lunar regolith and black soil ratios of 100% regolith, 80% regolith/20% black soil, 60% regolith/40% black soil, and 50% regolith/50% black soil, the soybeans grew tallest in the 80% regolith/20% black soil ratio. The plants in the 80% lunar regolith/20% black soil reached heights of 42 cm, 31 cm, & 28.5 cm for an average of a 33.8 cm of growth on the three plants. We had planted three pots of 100% black soil to use as our control and for validity of the soybean seeds ability to grow. Our 80% regolith/20% soil plants with an average growth of 33.8 cm outgrew the 100% black soil control group's average growth of 28.2 cm by 5.6 cm. This really surprised us. Our hypothesis was incorrect because we had predicted that the soybean planted in the 50% regolith/50% black Illinois soil would grow the tallest. The 50% regolith/50% soil had an average growth of 15 cm making it the second best results. The 100% regolith had our third best average of 9 cm and the worst ratio was the 60% regolith/40% soil with an average of only 6 cm of growth.

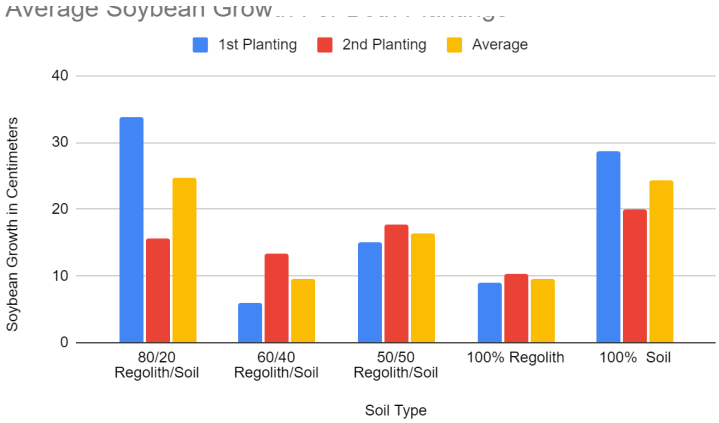
Literature CIted:
Title:Soybean Fertility - Soybean Research & Information Network - SRIN
Website title:Soybean Research and Information Network
URL:https://soybeanresearchinfo.com/agronomics/soybean-fertility/
Date accessed: February 8, 2023

Title:05 The Lunar Regolith_noble Compressed
Website title:NASA
URL:https://www.nasa.gov/sites/default/files/atoms/files/05_1_snoble_thelunarregolith.pdf
Date accessed: February 10, 2023

Graphs & Charts







PLANT GROWTH 2/22 - 3/27

	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C
2/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2/27	0	0	0.1	0.1	0	0	0.1	0.1	0	0.1	0	0	0	0	0.1
3/1	0	0	0.1	0.1	0	0.1	0.1	0.5	0	0.7	0.1	0	0	0	0.1
3/3	0	0	0.1	0.1	0	0.1	0.1	0.5	0	0.5	0.1	0	0	0	0.1
3/6	0.1	0	0.1	1	0	0.1	1	3	0.3	2	1	0	0	0	4
3/8	0.1	0.1	1	1	0	0.1	1	7.5	1	6	2	0.1	0.1	1	9.5
3/10	0.3	2.5	1	1	0.5	1.5	1	10.5	1.5	7	3.5	0.3	0.1	2.5	12.5
3/13	2.5	2.5	1	1	7	2	2	15	7.5	7	3	0	1	2.5	15
3/15	6	5	4	0	12	2	2	17	12	11	3.5	0	6.5	13	19
3/17	8	6	5	0	16.5	3	2	19	16	13	3.5	0	14.5	18.5	21
3/20	14	8.5	7.5	0	21	5	5.5	19	21	20	3.5	1	18	20	21
3/22	14.5	10	14.5	0	22.5	7	6.5	19	21	21	9	1	19	20	21
3/24	16	12	19	0	24.5	15.5	13	19	21	22	18.5	1	19	20	21
3/27	ALL PLANTS WERE DEAD AND REPLANTED														

PLANT GROWTH 3/27 - 4/19

	1A	1B	1C	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B	5C
3/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/31	0	1	0.5	1	0	0	0.1	0.5	0	0	0	0	0.1	0.1	0.5
4/3	0	10	7	7	0	0	2	4	0.5	2	0	0	6	1	9.5
4/5	2.5	13	11.5	10.5	0	0.5	6.5	5	0.5	6	0.5	0	10	2	13.5
4/6	5.5	13	12.5	11	0	1	9.5	5	3	6	0.5	0	11	3	14
4/11	13	25	18.5	18	0	2	17.5	5	3	8	2	1.5	16	4	22.5
4/13	20	28	19	20	0	5	21	5	3	10	4	0	17	8	24
4/17	29	38	26	29	0	8	33	6	3	12	3	7	23	16	38
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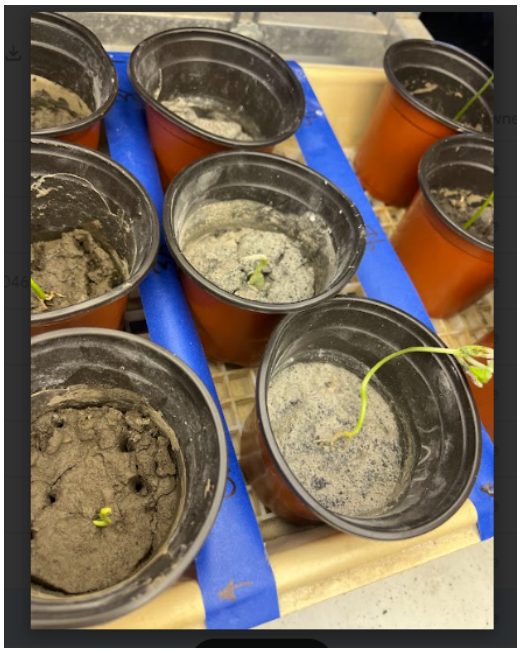
Photos