National Science Fair
Display sheet

Project ID	**NSF-SCH2025-94**
Project Title	**From Peel To Plant: Making Fertilizer Pellets From Dragon Fruit Peel And Testing Their Effect On Pea & Brinjal Plant Growth**
Level	**Middle level**
Category	**Environmental Science**
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ABSTRACT:

In this study I have explored how dragon fruit peel, a common household waste, can be recycled into an eco-friendly fertilizer. The reason why I have chosen dragon fruit peel for my project is that it contains fiber, calcium, magnesium, and natural organic matter that can help plant growth. In this research, fertilizer pellets were made by drying, grinding, and shaping dragon fruit peel into small pellets. These were tested on pea plants growth and brinjal plants growth compared with plants given commercial fertilizer and those grown without fertilizer. Observations on percentage of germination, plant height, size of leaves and leaf growth were recorded over three weeks. Results showed that plants treated with dragon fruit peel pellets grew taller and healthier than those without fertilizer, though slightly less than those with commercial fertilizer. This shows that dragon fruit peel can be turned into a useful, biodegradable, and low-cost organic fertilizer, reducing fruit waste and promoting sustainable gardening.

INTRODUCTION:

Modern agriculture often depends on chemical fertilizers that can harm the soil and environment over time. At the same time, large amounts of fruit waste, including dragon fruit peel, are discarded daily. Dragon fruit (Hylocereus polyrhizus) has a thick peel rich in minerals, fiber, and antioxidants that can benefit plants and soil when decomposed naturally.

The peel of the dragon fruit has the potential to be a great source of bioactive compounds, even though its flesh is often eaten. Numerous phytochemicals, including phenolic compounds, flavonoids, carotenoids, and pectin, are found in the peel of dragon fruit and have been shown to have many health benefits.

Turning this peel into fertilizer pellets makes it easier to handle, less smelly, and more effective for controlled nutrient release. Using organic waste in this way helps reduce pollution, supports sustainable farming, and provides a simple, affordable solution for home gardeners. This study focuses on preparing fertilizer pellets from dragon fruit peel and testing their effect on plant growth compared to commercial fertilizer.

STATEMENT OF THE PROBLEM:

Chemical fertilizers are widely used to increase crop yield, but their long-term use can damage soil quality, increase costs, and harm the environment. Meanwhile, large quantities of dragon fruit peel are wasted, even though they contain valuable nutrients.
The problem this research addresses is:

How can dragon fruit peel waste be converted into an effective fertilizer pellets form that supports plant growth while reducing organic waste?

HYPOTHESES:

1. Primary Hypothesis:

Pea plants and brinjal plants grown with dragon fruit peel fertilizer pellets will show better germination, growth, and health than plants grown without any fertilizer.

2. Secondary Hypothesis:

Pea plants and brinjal plant grown with commercial fertilizer will show the highest growth overall, but dragon fruit peel pellets will perform better than no fertilizer and may provide a more eco-friendly alternative.

3. Null Hypothesis (for scientific balance):

Dragon fruit peel fertilizer pellets will have no significant effect on plant germination or growth compared with plants grown without fertilizer.

PROCEDURE: — Making the pellets

1. **Collect peel:** peels were saved from 3–4 dragon fruits. Rinsed to remove pulp.
2. **Dry the peels:**
   - Oven method (adult help): peels were spread on a baking tray and dried at low temperature (about 60–80°C / 140–175°F) for 3–4 hours until crisp.
   - Sun method: peels were laid in direct sun on a tray for 2–4 days until fully dried.
3. **Grind:** Once dried, ground the peels into a powder using a blender or mortar & pestle.
4. **Make pellet mix:** 10 g of peel powder mixed with 2 g corn starch (binder). Small spoons of water was added and (optionally) 1 ml molasses to help bind. It was stirred until a dough was formed. Amounts were scaled up.
5. **Form pellets:** small pellets were shaped (about 0.5–1 cm diameter) using a spoon, small mold, or by hand.
6. **Dry pellets:** Pellets were shaped on a parchment paper and dried in oven at low heat (or in sun) until hard (2–6 hours).
7. **Store:** Kept in a dry container until planting.

Experimental setup (plant test)

1. Label pots: 9groups +9 replicates = 18 pots. Plants were labelled from A1–A3 = No fertilizer pellets, plant A1–A3 = Dragon peel pellets; plant B1–B3 = No fertilizer pellets, plant B1-B3 with fertilizer pellets, plant A1-A3 Commercial fertilizer, plant B1-B3 commercial fertilizer.

2. Fill pots: the same amount of potting soil was put in each pot.

3. Plant seeds: Planted 1 pea seed per pot at same depth (2–3 cm). The same for brinjal seeds.

4. **Add treatment:**
5. • **No fertilizer:** added nothing.

• Dragon pellet: 1-3 pellets were buried approx 2–3 cm below seed (or next to seed) at planting. {Increase the number of pellets when going from pot 1 to pot 3 for each experimental plant set up (brinjal and pea plant seeds)}

• **Commercial:** added recommended small dose (e.g., ¼ measured dose per pot) at planting (to follow adult guidance).

6. **Water & place:** same amount of water was sprayed for each pot and placed all pots in same light location.

7. **Record:** Noted date of planting as Day 0.

Data collection schedule & how to record

• Day 0: Planting.

• Day 7: Check germination. Recorded how many seeds sprouted (germination rate).

• Every 3 days (e.g., Days 3, 6, 9, 12, 15, 18, 21, 24, 27): Measure plant height from soil to top (cm) and record number of leaves for each treatment (negative control, experimental control, positive control) for both plants pea and brinjal.

• Day 27 (4 weeks): final measurements taken: height, leaves, and visual health score (1–5). photos taken.

COLLECTION OF DATA:

Collection of dragon fruit peel and Preparation of fertilizer pellet

Dragon fruit peel

Dragon fruit peel after drying for over 2 days

Dragon fruit peel after grinding

Dragon peel pellet

Brinjal plant without adding any Fertilizer day 1

Brinjal plant with commercial fertilizer after 6 days

Brinjal plant with fertilizer pellet after 27 days

Pea plant without any fertilizer day 3

Pea plant with commercial fertilizer day 27

Pea plant with fertilizer pellet day 27

DATA ANALYSIS

Plant A (Pea Plant): Study on the growth of Plant A in Three pots without any fertilizer over a period of 27 days.(Control)

S. no	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Pot			Average	Pot			Average	Pot			Average
		1	2	3		1	2	3		1	2	3	
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	2	2	2	2	0	0	0	0	0	0	0	0
3	Day 9	3	3	3	3	2	2	2	2	0.5	0.5	0.5	0.5
4	Day 12	4	4	4.5	4.2	7	8	8	7.7	1	1	1.5	1.2
5	Day 15	8	8	9	8.3	14	14	14	14	1.5	1.5	2	1.7
6	Day 18	11	11	12	11.3	16	16	17	16.3	2	2	2	2
7	Day 21	12	12	13	12.3	19	19	19	19	2.5	2.5	2.5	2.5
8	Day 24	13.5	13.5	14	14	21	21	21	21	2.5	2.5	2.5	2.5
9	Day 27	15	15	15	15	23	23	23	23	3	3	3	3

Plant A with fertilizer pellet: (Comparison of the growth of plant A with control Vs dragon peel fertilizer pellet over a period of 27 days)

S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	2	2	2	2	0	0	0	1	0	0	0	0.5
3	Day 9	3	3	3.5	3.5	2	2	2	2	0.5	0.5	0.5	1
4	Day 12	4.2	5	5	4	7.7	8	8	9	1.2	1.5	1.5	1.5
5	Day 15	8.3	9	9	9	14.3	14	14	15	1.7	2	2	2
6	Day 18	11.3	12	12	12.5	16.3	18	18	19	2	2.5	2.5	2.5
7	Day 21	12.3	14	14	15	19	20	20	21	2.5	3	3	3
8	Day 24	14	15.5	15.5	16	21	23	23	24	2.5	3.5	3.5	4
9	Day 27	15	17	17	17.5	23	25	25	26	3	4	4.5	4.5

Plant A with commercial fertilizer: (Comparison of the growth of plant A with control Vs commercial fertilizer over a period of 27 days)

S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pot1	Pot 2	Pot 3	Control (Avg)	Pot 1	Pot 2	Pot 3	Control (Avg)	Pot 1	Pot 2	Pot 3
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	2	2	2	2	0	1	1	1	0	0.5	0.5	0.5
3	Day 9	3	3	3	3	2	2	2	2	0.5	0.5	0.5	0.5
4	Day 12	4.2	4	4	4.5	7.7	8	8	8	1.2	1.5	1.5	1
5	Day 15	8.3	8	8	8	14.3	14	14	14	1.7	2	2	1.5
6	Day 18	11.3	12	12	12	16.3	18	18	18	2	2.5	2.5	2
7	Day 21	12.3	14	14	14	19	20	20	20	2.5	3	3	3
8	Day 24	14	15	15	15	21	23	23	23	2.5	4	4	4
9	Day 27	15	17	17	17	23	25	25	26	3	4.5	4.5	4.5

Plant B (Brinjal Plant): Study on the growth of Plant B in Three pots without any fertilizer over a period of 27 days.(Control)

S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Pot			Average	Pot			Average	Pot			Average
		1	2	3		1	2	3		1	2	3	
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	1	1	1	1	0	0	0	0	0	0	0	0
3	Day 9	2	2	2	2	2	3	3	2.7	0.1	0.1	0.1	0.1
4	Day 12	3	3	3	3	8	8	8	8	0.5	0.5	0.5	0.5
5	Day 15	4	4	4.5	4.2	14	14	15	14.3	1	1	1	1
6	Day 18	6	6	6	6	20	20	21	20.3	1	1.2	1.2	1.13
7	Day 21	7	7	7.5	7.2	24	25	25	24.7	1	1	1.5	1.17
8	Day 24	8	8	8	8	29	29	29	29	1.8	2	2	1.9
9	Day 27	9	9	9.5	9.2	30	30	30	30	2.2	2.2	2.2	2.2

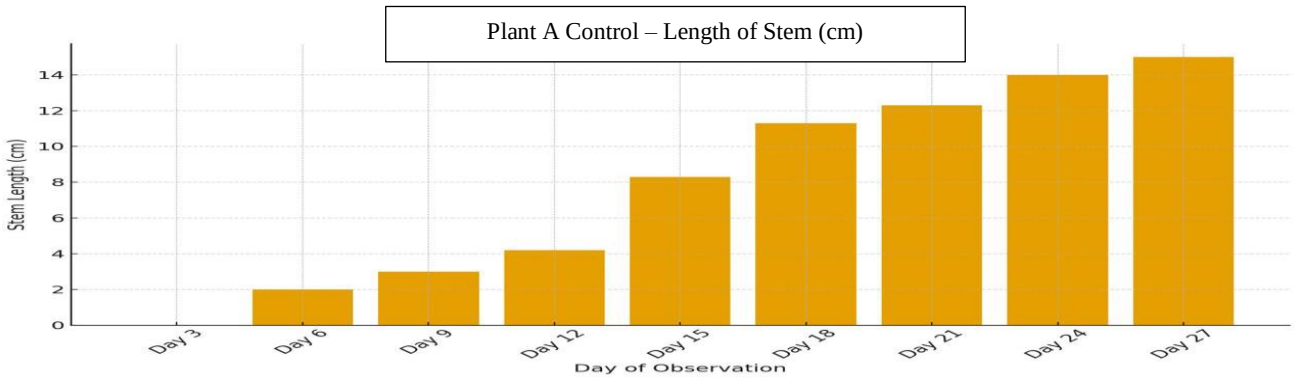
Plant B with fertilizer pellet: (Comparison of the growth of plant B with control Vs dragon peel fertilizer pellet over a period of 27 days)

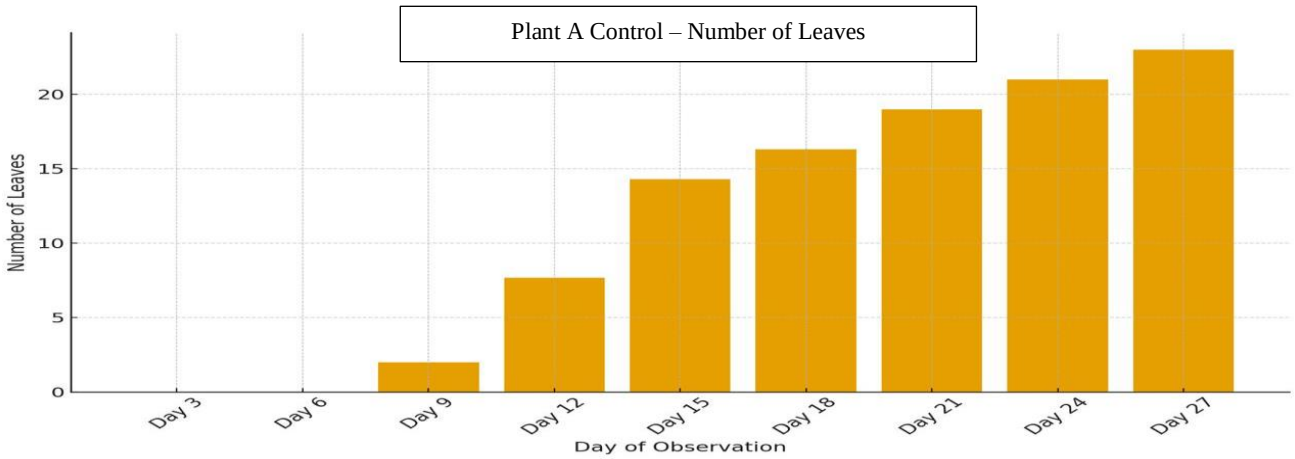
S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	1	1	1.2	1.5	0	0	0	0	0	0	0	0
3	Day 9	2	2	2.5	2.5	2.7	3	3	3	0.1	0.2	0.2	0.2
4	Day 12	3	3	3.5	3.5	8	8	9	9	0.5	0.5	0.5	0.5
5	Day 15	4.2	5	5	6	14.3	15	15	16	1	1	1	1
6	Day 18	6	7	7	7.5	20.3	20	21	22	1.13	1.3	1.3	1.3
7	Day 21	7.2	8	8	8.5	24.7	25	25	26	1.17	1.5	1.5	1.5
8	Day 24	8	9	9	9.5	29	29	29	30	1.9	2	2	2
9	Day 27	9.2	10	10	10.5	30	35	35	35	2.2	2.5	2.5	2.5

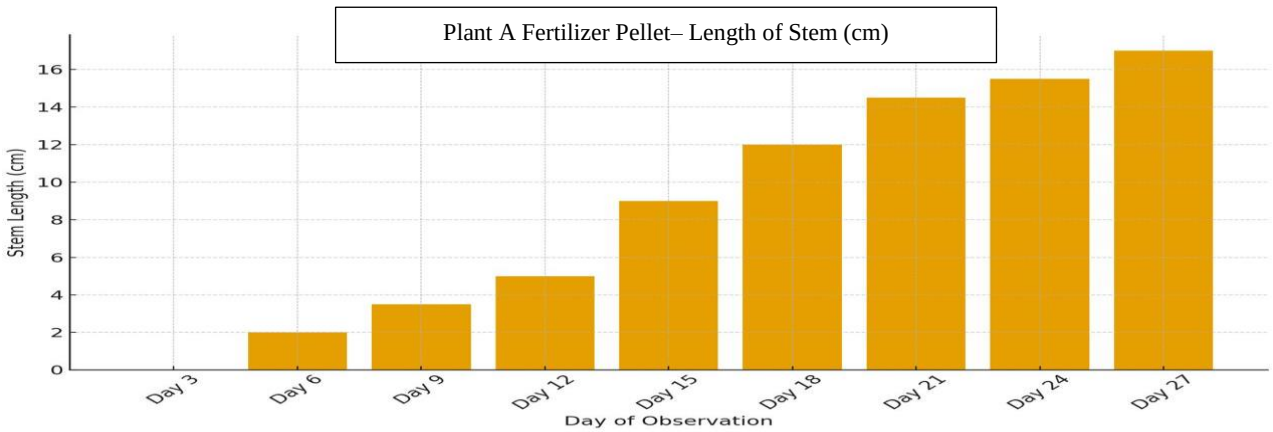
Plant B with commercial fertilizer: (Comparison of the growth of plant B with control Vs commercial fertilizer over a period of 27 days)

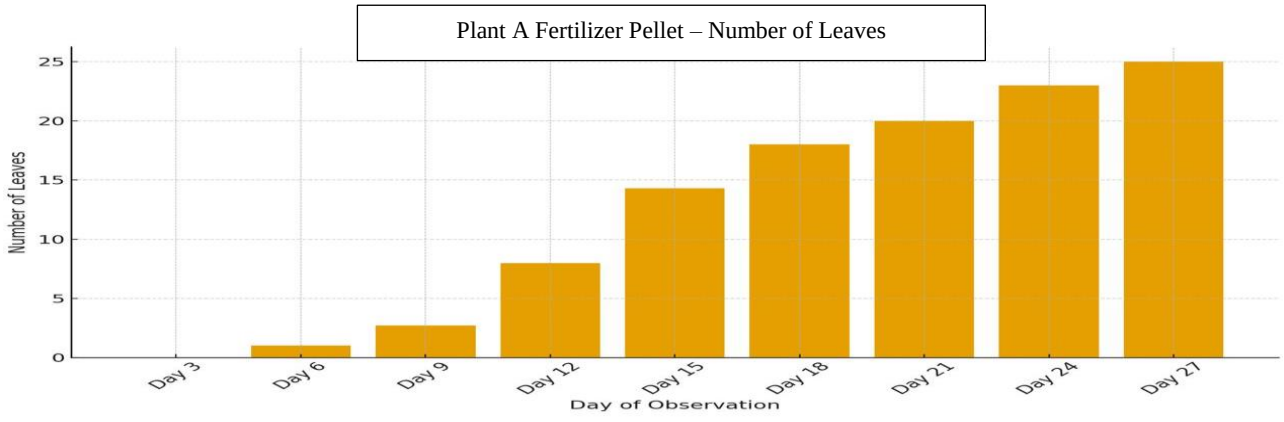
S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pot 1	Pot 2	Pot 3	Control (Avg)	Pot 1	Pot 2	Pot 3	Control (Avg)	Pot 1	Pot 2	Pot 3
1	Day 3	0	0	0	0	0	0	0	0	0	0	0	0
2	Day 6	1	1	1.2	1.2	0	0	0	0	0	0	0	0
3	Day 9	2	2	2	2	2.7	3	3	3	0.1	0.1	0.1	0.2
4	Day 12	3	3	3	3	8	8	8	8	0.5	0.4	0.4	0.4
5	Day 15	4.2	5	5	5	14.3	15	15	15	1	0.8	0.8	0.8
6	Day 18	6	7	7	7	20.3	20	20	20	1.13	1	1	1
7	Day 21	7.2	8	8	8	24.7	25	25	25	1.17	1.2	1.2	1.2
8	Day 24	8	9	9	9	29	28	28	29	1.9	1.8	1.8	1.8
9	Day 27	9.2	10	10	10	30	32	32	32	2.2	2.2	2.2	2.2

GRAPHICAL REPRESENTATION

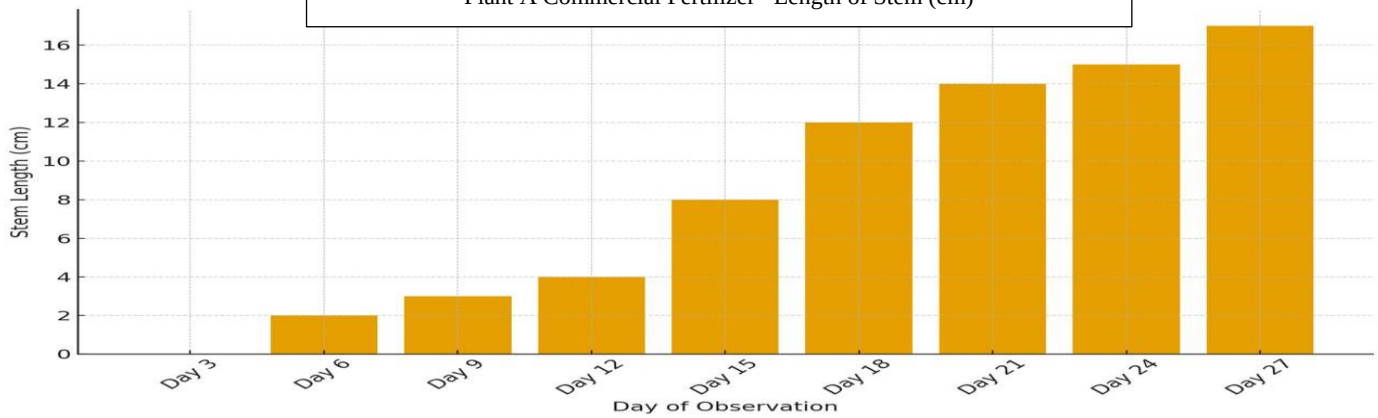




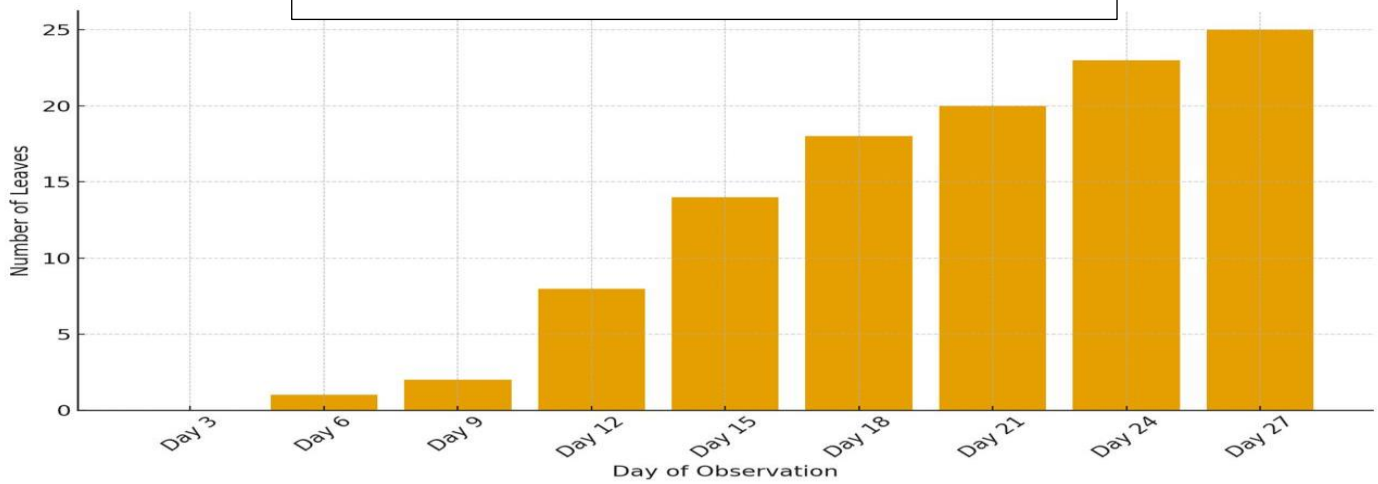




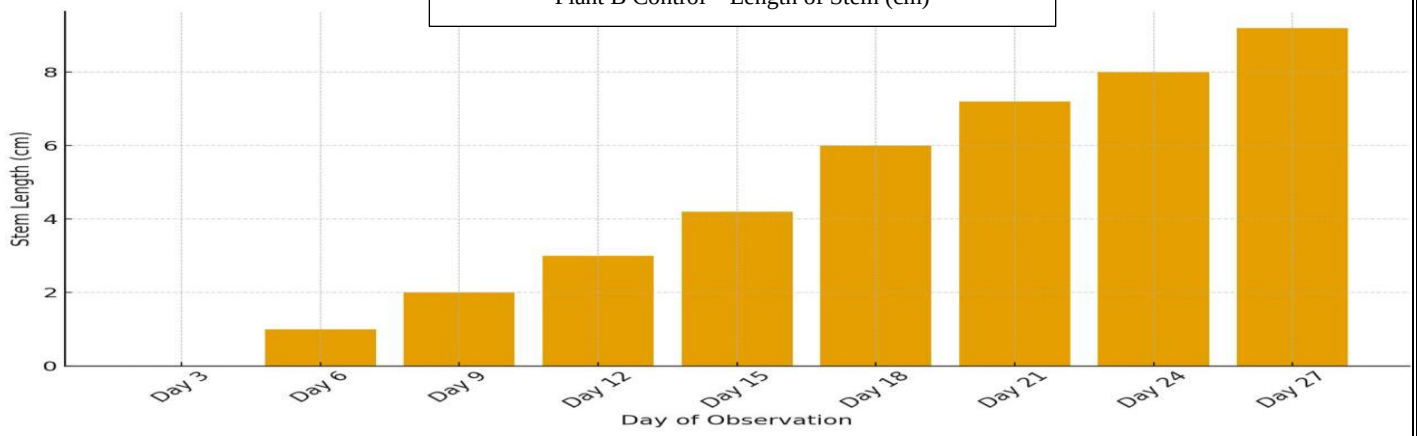
Plant A Commercial Fertilizer– Length of Stem (cm)



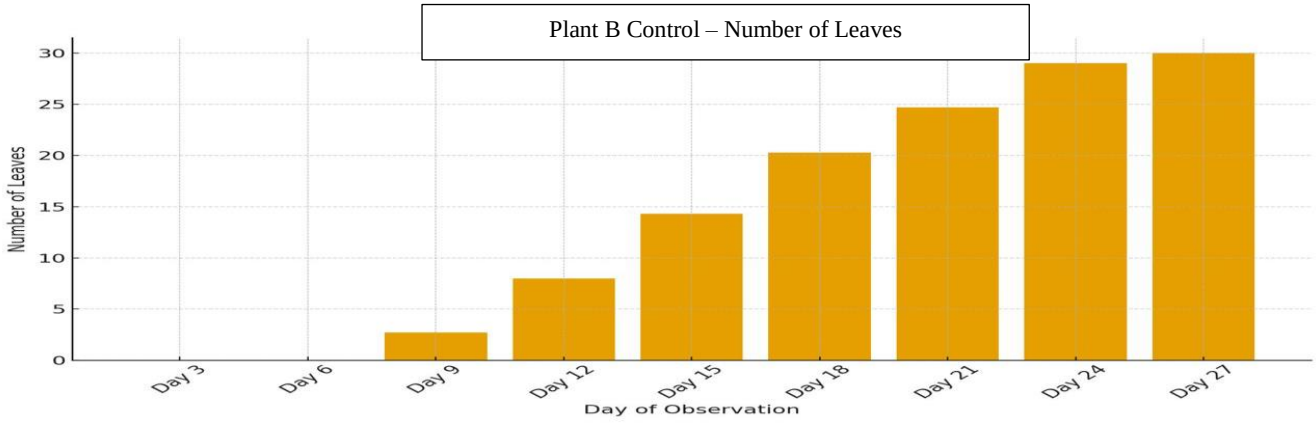
Plant A Commercial Fertilizer– Number of Leaves



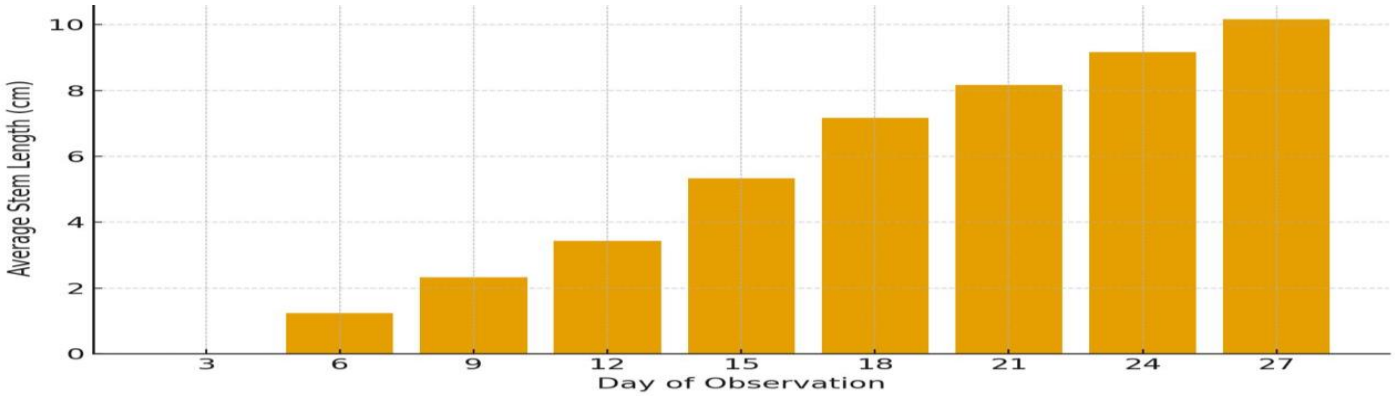
Plant B Control – Length of Stem (cm)



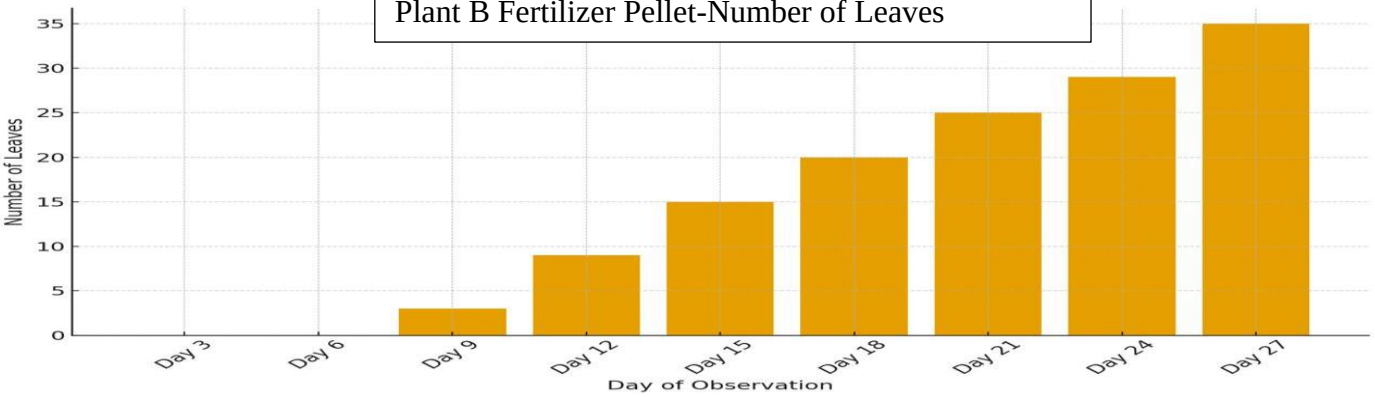
Plant B Control – Number of Leaves



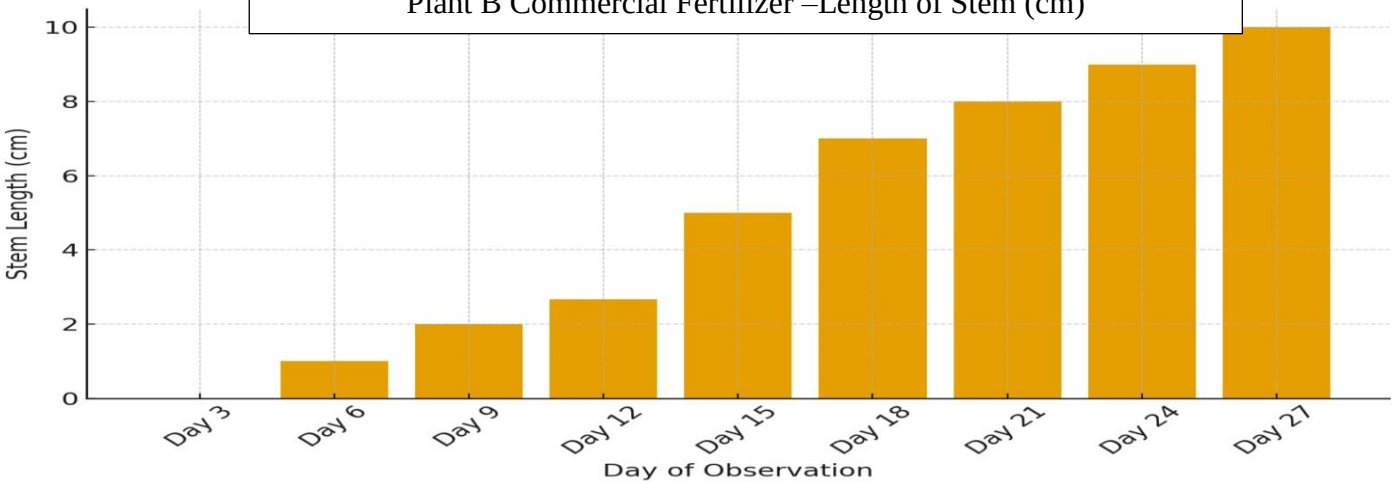
Plant B Fertilizer Pellet- Length of the Stem (cm)



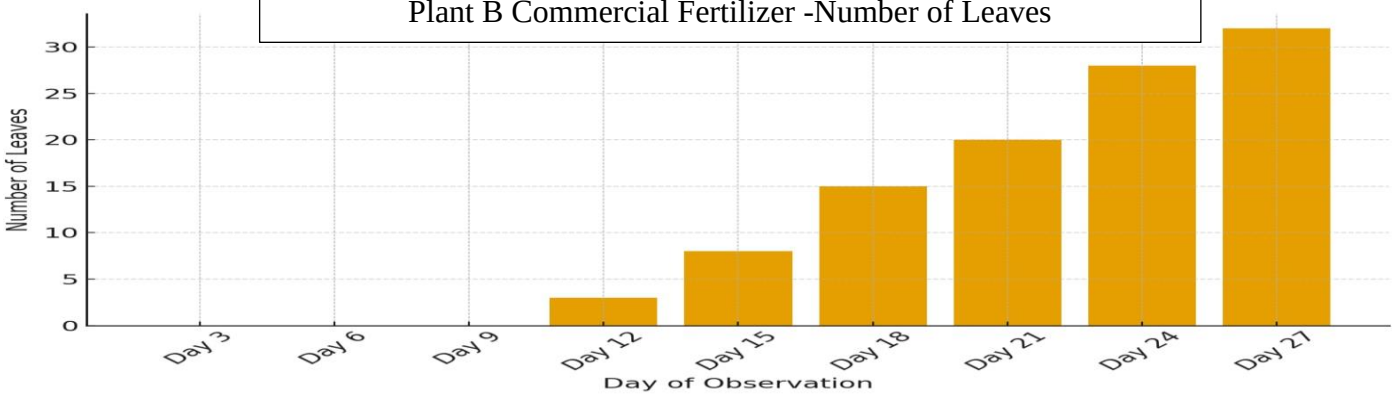
Plant B Fertilizer Pellet-Number of Leaves



Plant B Commercial Fertilizer –Length of Stem (cm)



Plant B Commercial Fertilizer -Number of Leaves



RESULTS:

The growth performance of the plants was evaluated using two parameters: length of stem and number of leaves across 27 days. The results clearly show that plants treated with fertilizers—both pellets and commercial—outperformed the control groups in most growth aspects.

1. Plant A (Control)

Plant A under control conditions showed steady but moderate growth, reaching a final stem length of 15 cm and producing 23 leaves by Day 27. Growth increased gradually without any sudden jumps, indicating normal development under limited nutrient availability.

2. Plant A with Fertilizer Pellet

Plants treated with fertilizer pellets exhibited stronger growth than the control. By Day 27, the stem length reached 17 cm, and the number of leaves increased to 25. This shows that slow-release nutrients from the pellet supported continuous and enhanced vegetative growth.

3. Plant A with Commercial Fertilizer

Commercial fertilizer also produced significant improvement compared to the control. The stem length reached 17 cm, similar to the pellet group, and leaf count also reached 25 leaves. The growth trend was stable throughout, indicating efficient nutrient uptake from the commercial fertilizer.

4. Plant B (Control)

Plant B in control conditions produced a final stem length of 9.2 cm, which is much lower than Plant A. However, the number of leaves was comparatively high, reaching 30 leaves. This suggests that Plant B naturally prioritizes leaf formation over stem elongation even without additional fertilizer.

5. Plant B with Fertilizer Pellet

Fertilizer pellets significantly improved leaf production in Plant B. The stem length reached 10 cm, and leaf numbers increased to 35 leaves, the highest among all treatments. This indicates that pellet fertilizer particularly benefits leafy growth in Plant B.

6. Plant B with Commercial Fertilizer

The commercial fertilizer resulted in exceptional stem growth for Plant B, reaching 10 cm over 27days, which matched the highest height recorded in Plant A. Leaf production was good, ending with 32 leaves, showing a balanced growth response.

Thus slow-release pellet fertilizer favored leaf development and stem elongation.

DISCUSSION:

1. Fertilizer Pellet vs Commercial Fertilizer

- Both fertilizers significantly increase growth compared to controls for both Plant A and B.

- Plant A responds strongly to fertilizer pellets, with similar maximum heights (17 cm).

- Plant B responds much more to commercial fertilizer for stem growth, reaching 10 cm, whereas the pellet also produced 10 cm.

2. Plant A vs Plant B Growth Behavior

- Plant A shows overall better stem growth, especially with dragon fertilizer pellets, proving it is more responsive in height.

- Plant B shows better leaf formation, especially with the fertilizer pellet, indicating a stronger leaf-oriented growth response.

3. Why Leaf Growth Differs

- Plant B naturally produces more leaves even in the control (30 leaves), suggesting:

- A species-based higher photosynthetic allocation to leaves

- Stronger vegetative propagation

- The pellet fertilizer seems to release nutrients slowly, which benefits leaf growth long-term.

4. Nutrient Uptake Patterns

- Plants under fertilizer show a jump in growth between Days 9–18, which corresponds to active nutrient uptake during mid-vegetative stages.
- Control plants grow but at a slower and more linear rate due to limited nutrient availability.

CONCLUSION:

1. Both fertilizers (pellet and commercial) significantly improve plant growth in terms of both stem length and leaf number.

2. Plant A shows maximum height increase, especially with fertilizers.

3. Plant B shows maximum leaf development, particularly with the fertilizer pellet, reaching 35 leaves—the highest among all groups.

4. Commercial fertilizer is best for rapid stem elongation, especially in Plant B.

5. Fertilizer pellet is best for sustained leaf production, particularly in both Plant A and B.

6. Overall, both fertilized plants using dragon fruit pellets outperform control plants consistently across all observation days proving that the given hypothesis is partially true.

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The Journal of Terapan Teknik Mesin: Design of organic fertilizer pellet machine… — about pelletizing organic waste: showing that making pellets from organic fertilizer can make a more convenient and effective fertilizer product.

Ramil, M. D. I., et al. Assessment on the Physicochemical and Phytochemical Properties, Nutritional and Heavy Metal Contents, and Antioxidant Activities of Hylocereus polyrhizus (red dragon fruit) peel from Northern Philippines. Indian Journal of Science and Technology, 2021 — reports detailed values for peel moisture, ash, fat, protein, dietary fiber, minerals (K, Ca, Mg, Na), and antioxidant activity

"Quality improvement of feed chemical composition with the addition of dragon fruit skin flour (Hylocereus polyrhizus)" — shows data on carbohydrate, crude fiber, ash, protein, fat in dragon fruit peel flour and its application to improve feed quality"

ACKNOWLEDGEMENT

- Praising the Almighty, for giving me good strength throughout my research work and enabling me to complete the fair project successfully.

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- I would like to thank my parents who helped and motivated me a lot for doing a science fair project