

## National Science Fair Synopsis

<b>Project ID</b>	<b>NSF-SCH2025-94</b>
<b>Project Title</b>	<b>From Peel To Plant: Making Fertilizer Pellets From Dragon Fruit Peel And Testing Their Effect On Pea &amp; Brinjal Plant Growth</b>
<b>Level</b>	<b>Middle level</b>
<b>Category</b>	<b>Environmental Science</b>
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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 bean 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.

## **DESIGN OF STUDY:**

### **a. Variables**

**Independent variable:** (Type of treatment applied at planting)

1. No fertilizer (negative control)
2. Dragon fruit peel pellets (experimental)
3. commercial fertilizer (positive control)

**Dependent variables** (what you will measure):

1. Germination rate (%) after 6 days
2. Plant height (length of stem) (cm) every 3 days
3. Number of leaves per plant at 3 weeks
4. Length of leaves (cm)
5. Visual health score (1-5) at 3 weeks (1 = very poor, 5 = excellent)
6. Constants (kept same for all pots):
7. Same seed type (peas and brinjal seeds), same number of seeds per pot.
8. Same pot size and soil type
9. Same water amount and schedule
10. Same light conditions (same window/shelf)
11. Same planting depth and pellet placement.

## **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: 9 groups + 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:**

- **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).

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

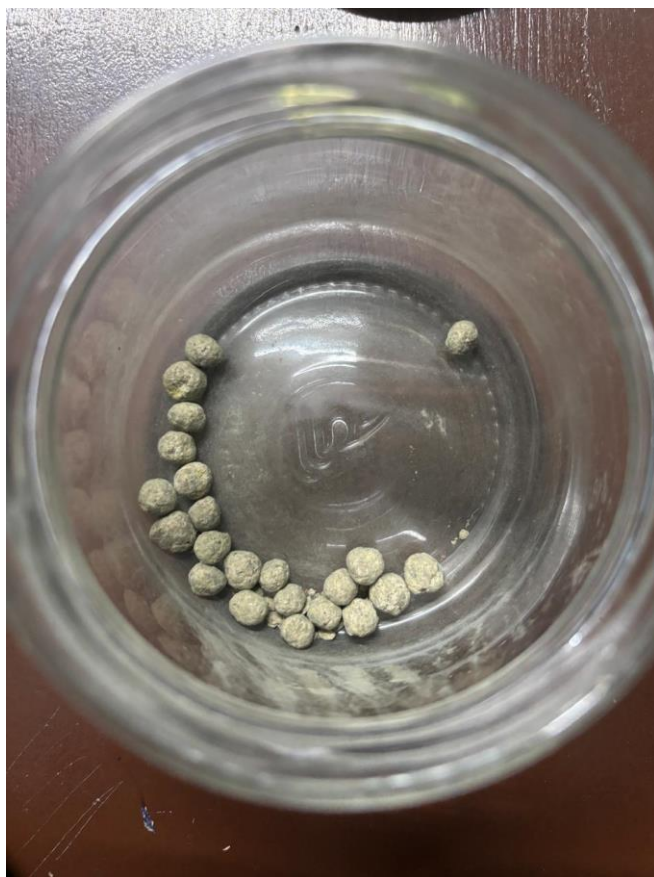
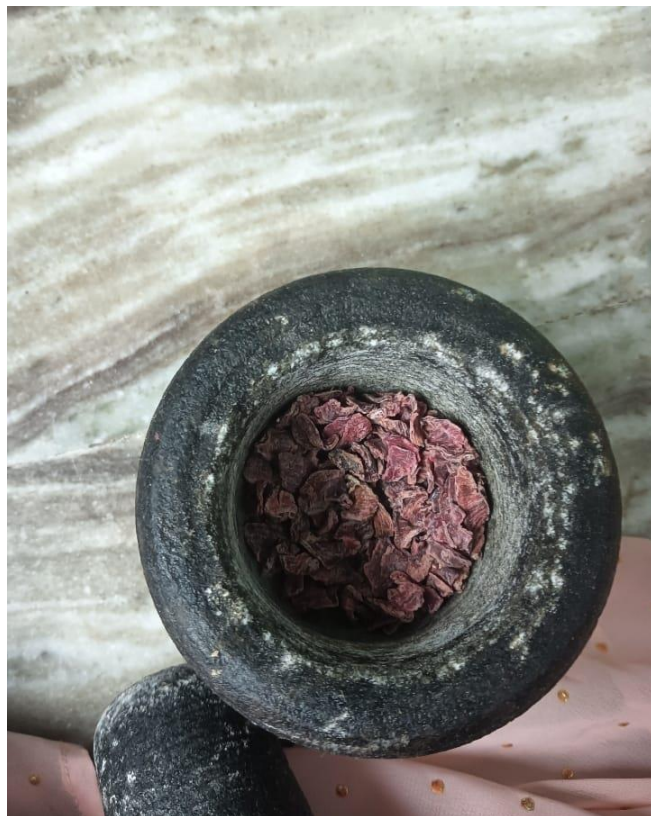
6. **Record:** Noted date of planting as Day 0.

## **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



Brinjal plant with fertilizer pellet after 27 days



Brinjal plant with commercial fertilizer after 6 days



Without adding any Fertilizer day 1



(Due to the unfavorable weather condition and inconsistent rain, certain recorded data of plant growth wasn't able to picture. Complete picture will be given in final report)

Pea plant with fertilizer pellet day 27



Pea plant with commercial fertilizer day 27



Pea plant without any fertilizer day 3



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	3	3	3	3	5	5	5	3	2	2	2	3
2	Day 6	5	5	5	3	10	10	10	3	4	4	4	3
3	Day 9	8	7	7	3	15	15	15	3	5	5	5	3
4	Day 12	13	13	13	3	20	20	20	3	10	10	10	3
5	Day 15	16	16	16	3	23	23	23	3	13	13	13	3
6	Day 18	19	19	19	3	25	25	25	3	15	15	15	3
7	Day 21	25	25	25	3	30	30	30	3	20	20	20	3
8	Day 24	30	30	30	3	35	35	35	3	25	25	25	3
9	Day 27	35	35	35	3	40	40	40	3	30	30	30	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	3	2	2	2	3	5	5	5	3	2	2	2
2	Day 6	3	5	5	5	3	10	10	10	3	6	6	6
3	Day 9	3	8	8	8	3	14	14	14	3	9	9	9
4	Day 12	3	14	14	14	3	18	18	18	3	13	13	13
5	Day 15	3	17	17	17	3	24	24	24	3	18	18	18
6	Day 18	3	20	20	20	3	26	26	26	3	22	22	22
7	Day 21	3	24	24	24	3	29	29	29	3	25	25	25
8	Day 24	3	30	30	30	3	35	35	35	3	28	28	28
9	Day 27	3	35	35	35	3	40	40	40	3	31	31	31

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	3	3	3	3	3	5	5	5	3	3	3	3
2	Day 6	3	6	6	6	3	10	10	10	3	6	6	6
3	Day 9	3	9	9	9	3	15	15	15	3	9	9	9
4	Day 12	3	15	15	15	3	20	20	20	3	12	12	12
5	Day 15	3	18	18	18	3	23	23	23	3	15	15	15
6	Day 18	3	25	25	25	3	26	26	26	3	18	18	18
7	Day 21	3	28	28	28	3	29	29	29	3	21	21	21
8	Day 24	3	31	31	31	3	32	32	32	3	24	24	24
9	Day 27	3	34	34	34	3	35	35	35	3	27	27	27

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	3	3	3	3	5	5	5	3	2	2	2	3
2	Day 6	6	6	6	3	10	10	10	3	5	5	5	3
3	Day 9	9	9	9	3	15	15	15	3	8	8	8	3
4	Day 12	12	12	12	3	20	20	20	3	11	11	11	3
5	Day 15	14	14	14	3	25	25	25	3	13	13	13	3
6	Day 18	17	17	17	3	30	30	30	3	15	15	15	3
7	Day 21	19	19	19	3	35	35	35	3	18	18	18	3
8	Day 24	23	23	23	3	40	40	40	3	20	20	20	3
9	Day 27	28	28	28	3	45	45	45	3	25	25	25	3

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)

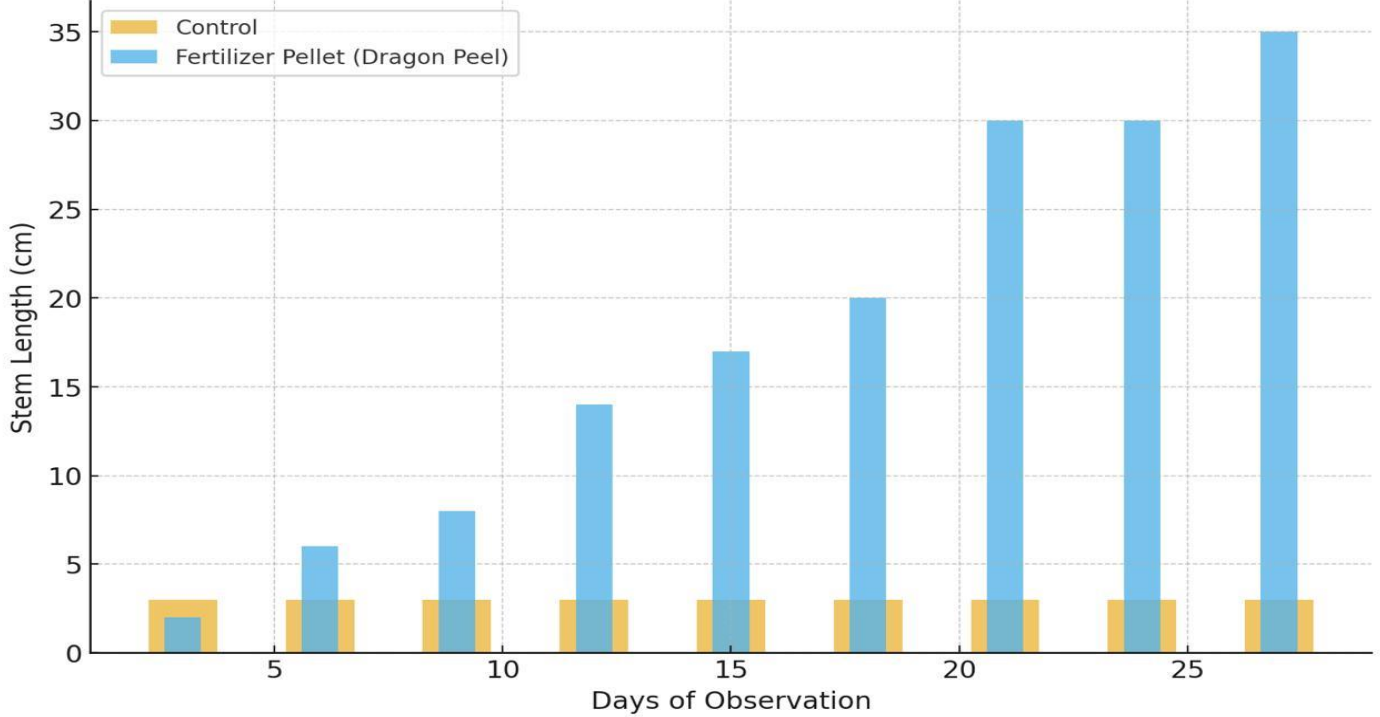
S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3
1	Day 3	3	5	3	3	3	5	5	5	3	2	4	3
2	Day 6	3	6	6	6	3	10	10	10	3	5	7	6
3	Day 9	3	10	10	10	3	15	15	15	3	8	10	9
4	Day 12	3	12	12	12	3	20	20	20	3	11	13	12
5	Day 15	3	15	15	15	3	25	25	25	3	14	16	15
6	Day 18	3	18	18	18	3	30	30	30	3	17	19	18
7	Day 21	3	20	20	20	3	35	35	35	3	20	22	21
8	Day 24	3	25	25	25	3	40	40	40	3	23	25	24
9	Day 27	3	28	28	28	3	45	45	45	3	29	29	29

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

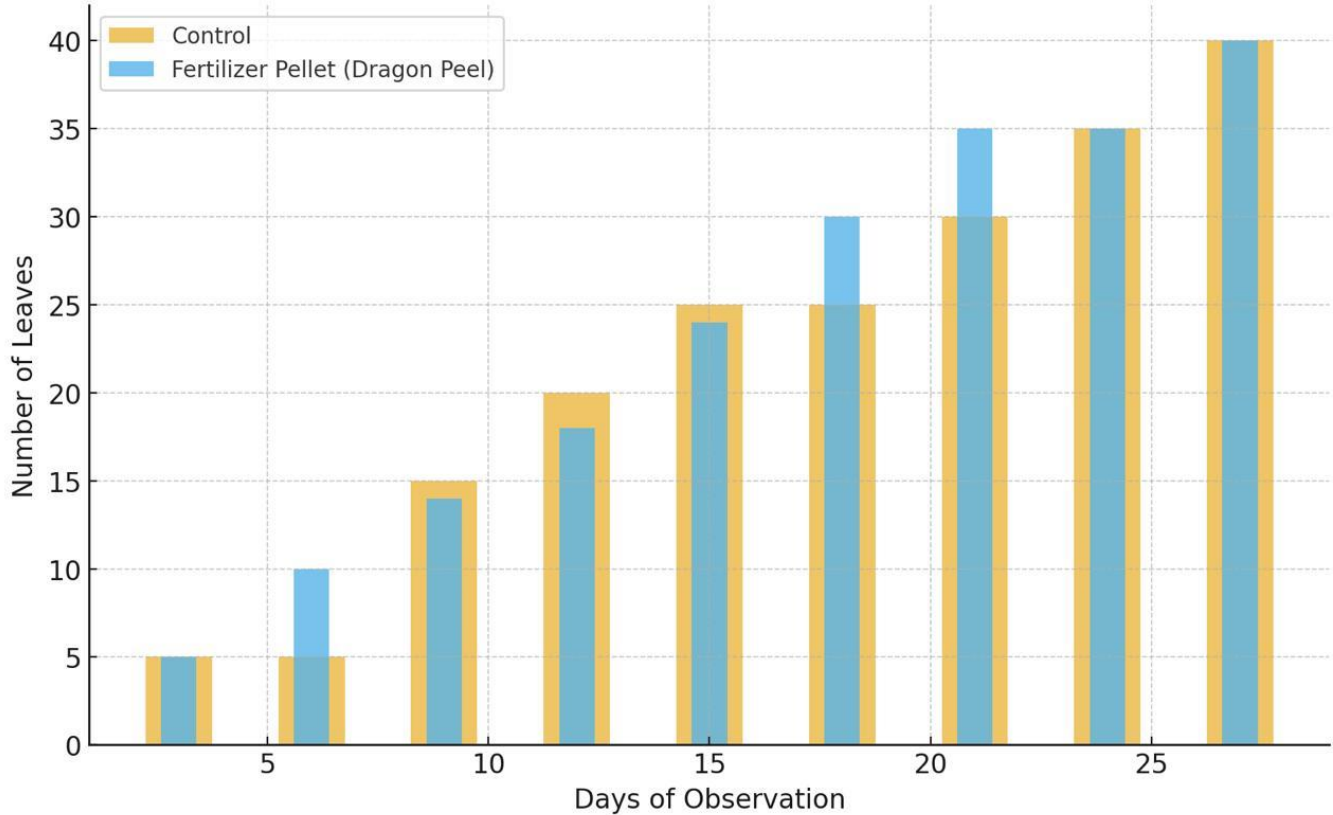
S. No	Day of Observation	Length of stem in cm				No. of leaves				Length of primary leaves			
		Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3	Control (Avg)	Pellet 1	Pellet 2	Pellet 3
1	Day 3	3	3	3	3	3	5	5	5	3	2	4	3
2	Day 6	3	5	5	5	3	10	10	10	3	5	7	6
3	Day 9	3	8	8	8	3	15	15	15	3	8	10	9
4	Day 12	3	11	11	11	3	20	20	20	3	11	13	12
5	Day 15	3	14	14	14	3	25	25	25	3	14	16	15
6	Day 18	3	17	17	17	3	30	30	30	3	17	19	18
7	Day 21	3	20	20	20	3	35	35	35	3	20	22	21
8	Day 24	3	23	23	23	3	40	40	40	3	23	25	24
9	Day 27	3	25	25	25	3	45	45	45	3	29	29	29

# GRAPHICAL REPRESENTATION

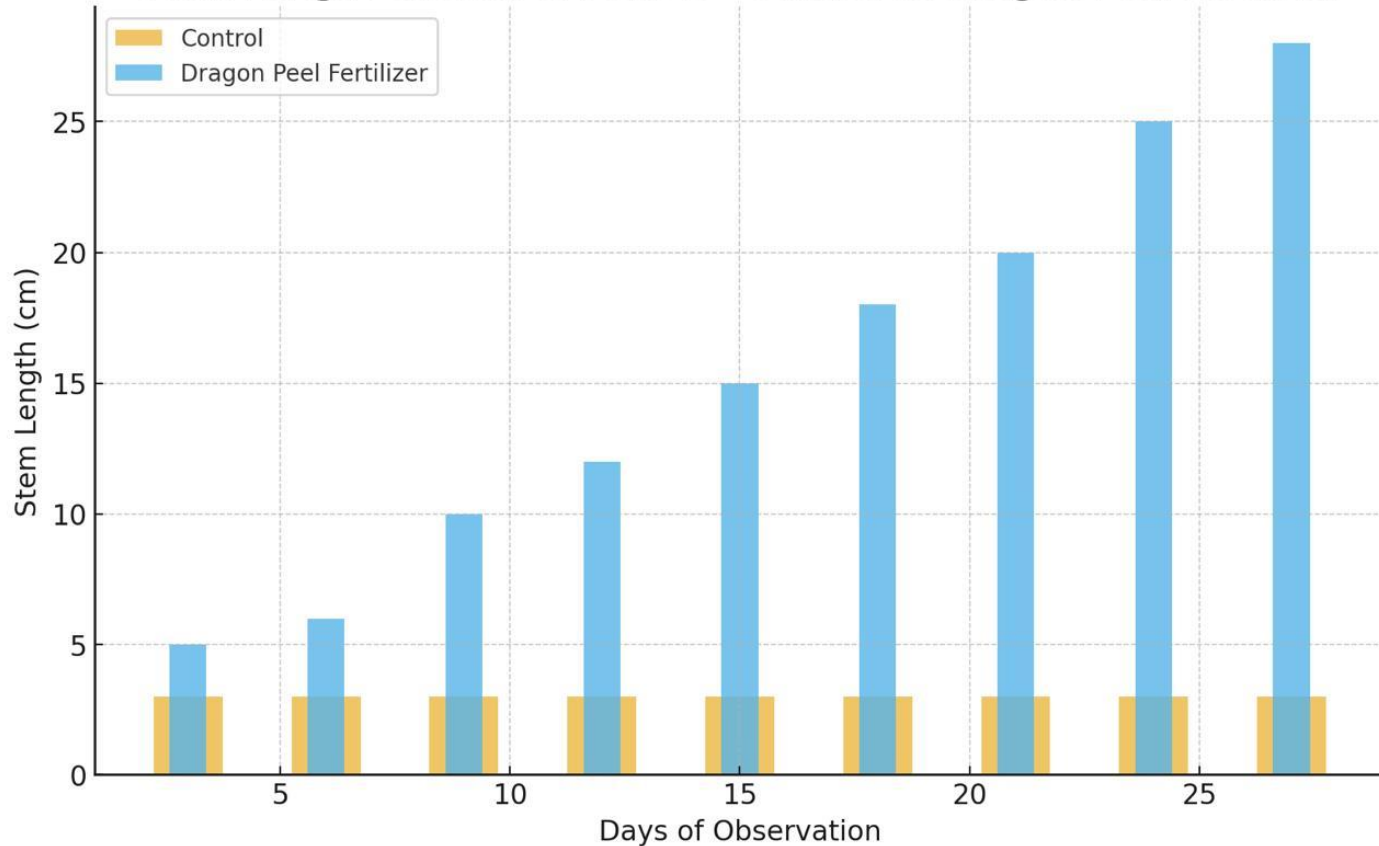
## Stem Length Growth of Plant A - Control vs Fertilizer Pellet (Dragon Peel)



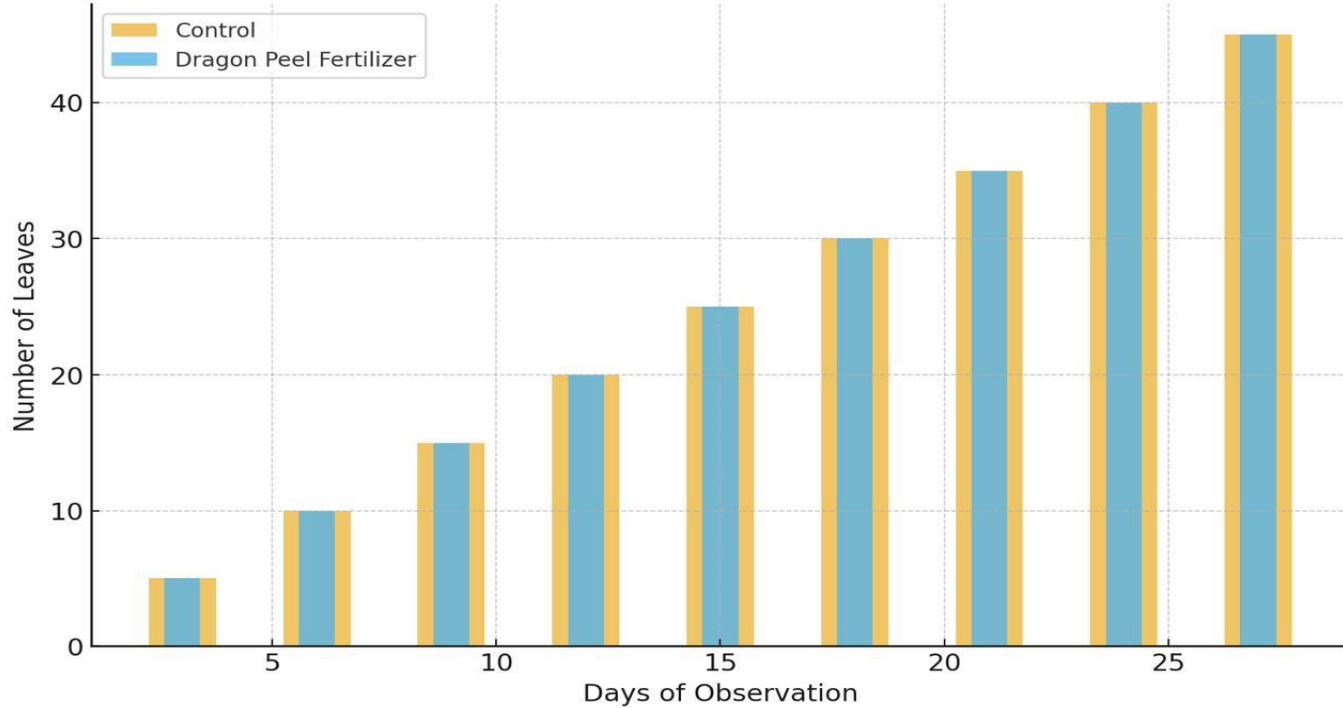
## Number of Leaves of Plant A - Control vs Fertilizer Pellet (Dragon Peel)



### Stem Length Growth of Plant B - Control vs Dragon Peel Fertilizer



### Number of Leaves of Plant B - Control vs Dragon Peel Fertilizer



## RESULTS:

1. Plant A (Control vs Dragon Peel Fertilizer Pellet):
  - Stem length increased from 3 cm to 35 cm in control, but up to 35 cm with fertilizer by day 27—similar final length but faster early growth.
  - Number of leaves grew from 5 → 40, same for both, but treated plants produced leaves earlier.
  - Primary leaf length increased from 3 → 30 cm (control) and 2 → 31 cm (fertilized), showing slightly greater expansion with fertilizer.
2. Plant B (Control vs Commercial Fertilizer):
  - Stem length: 3 → 25 cm in fertilized vs 3 → 3 cm in control — clear stimulation of growth.
  - Leaves: both reached 45 leaves, but treated plants achieved that number more quickly.
  - Leaf length: 3 → 29 cm in treated vs constant 3 cm in control, showing dramatic improvement.
3. Plant B (Control vs Dragon Peel Fertilizer):
  - Stem length rose to 28 cm (fertilized) vs 3 cm (control).
  - Number of leaves reached 45 faster than control.
  - Leaf length expanded to 29 cm vs 3 cm in control.
4. Plant A and B Controls:
  - Both controls (no fertilizer) showed little change in stem growth but steady leaf number increase, indicating slow vegetative development without nutrients.

## DISCUSSION

- Nutrient influence: Both commercial and dragon peel fertilizers significantly improved growth metrics compared with control.
- Early stimulation: Fertilized plants showed rapid elongation and leaf initiation as early as Day 6–9, whereas controls remained static until Day 18.
- Comparison of fertilizers:
  - Commercial fertilizer gave consistently higher stem and leaf growth for Plant B.
  - Dragon peel fertilizer provided comparable outcomes, proving effective as an eco-friendly organic alternative.
- Plant response: Plant B (brinjal) responded more dramatically to fertilization than Plant A (pea), implying higher nutrient demand.

## CONCLUSION:

- Fertilization—whether commercial or organic—markedly enhanced plant growth, leaf production, and foliage size.
- Dragon peel fertilizer pellets proved nearly as effective as commercial fertilizer, supporting their potential as sustainable soil amendments.
- Control plants lagged behind in all parameters, confirming the importance of nutrient supplementation.
- Future improvements may test optimized pellet composition and long-term soil health effects.

## REFERENCES:

FAO AGRIS record: Nutritional content and utilization of dragon fruit (*Hylocereus polyrhizus*) peels — documents phytonutrients (polyphenols, flavonoids, anthocyanidin), and short-chain fatty acid production in peel waste, plus product usage (e.g. jams) to reduce waste.

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”