

National Science Fair Research Paper

**COMPARATIVE STUDY OF REUSED PAPER  
PRODUCTS INTO PLANT-ABLE SEED PAPER**

**PROJECT ID: NSF-SCH-2025-135**

**Project Title:** Comparative Study of Reused Paper Products into  
Plant-able Seed Paper.

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## **I. ABSTRACT**

**Project Title:** Comparative Study of Decomposition of Different Biodegradable Products.  
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My project focuses on the innovative use of recycled paper to create plantable seed paper, an eco-friendly alternative that reduces waste while promoting greenery. Plantable paper is made by embedding seeds into sheets of reused paper pulp. Instead of being discarded after use, the paper can be planted in soil, where the seeds germinate and grow into plants. The study compares four different types of reused paper or newspaper, notebook paper, colored paper, and cardboard—to determine which produces the most effective seed paper for germination.

The experiment involved preparing pulp from each paper type, mixing in seeds such as mustard, coriander, and fenugreek, and forming sheets of seed paper. The seed papers were then tested for germination rates and growth. Observations revealed that notebook paper provided the best results, showing quicker and higher germination, followed closely by newspaper. Colored paper showed slower growth due to ink chemicals, while cardboard proved less effective because of its thickness and rigidity.

The findings highlight the potential of seed paper as a sustainable solution to both waste management and reforestation.

This project demonstrates how simple recycling practices can inspire environmental responsibility and encourages the adoption of plant-able seed paper in schools, homes, and industries.

## II. INTRODUCTION

This research focuses on the innovative concept of converting waste and reused paper into plant-able seed paper. Plant-able paper is a biodegradable, eco-friendly material that has seeds embedded inside. After its use, instead of being thrown away, this paper can be planted in the soil, where it will germinate and grow into plants. The study compares different types of reused paper (such as newspaper, notebook paper, colored paper, and cardboard) to determine which one produces the best quality seed paper for germination.

Paper waste has become a serious environmental concern in modern society. Every year, millions of tons of paper are discarded after single use. The production of fresh paper requires cutting down trees, which increases deforestation and contributes to climate change. Recycling and reusing paper not only reduce deforestation but also minimize landfill waste and pollution. By creating seed paper, we add extra value to recycled paper since it contributes to a greener environment.

In recent years, the world has witnessed a significant shift towards sustainable and eco-friendly practices, driven by growing concerns about environmental degradation, climate change, and waste management. One of the most pressing issues is the massive amount of paper waste generated every year, which contributes to deforestation, pollution, and landfill waste. To mitigate this problem, innovative solutions like plantable seed paper have emerged as a promising alternative.

The increasing demand for paper products has led to a significant rise in paper waste, posing a substantial threat to the environment. The paper industry is one of the largest consumers of wood pulp, contributing to deforestation and habitat loss. Moreover, the production process involves chemicals and energy, further exacerbating environmental degradation. However, innovative solutions like plantable seed paper offer a promising alternative. By embedding seeds into recycled paper, we can create a product that not only reduces waste but also promotes reforestation and biodiversity.

This study aims to explore the potential of different types of reused paper, including newspaper, notebook paper, colored paper, and cardboard, in producing high-quality seed paper. The research will investigate the physical and chemical properties of each paper type, as well as their germination rates, to determine the most suitable option for seed paper production.

The findings of this study can contribute to the development of sustainable paper products, reduce waste, and promote eco-friendly practices. Additionally, the use of seed paper can raise awareness about environmental conservation and encourage individuals to act towards a more sustainable future.

Paper waste is one of the largest contributors to global waste pollution. Most paper products are used once and discarded, ending up in landfills. While large-scale recycling facilities exist, they require heavy industrial processing, machinery, and energy. On the other hand, small-scale methods, such as turning paper into seed paper, can be done at homes, schools, or community projects with minimal resources.

The central problem lies in people's tendency to throw away paper instead of reusing it. This project highlights that if paper is reused to make seed paper, it not only reduces waste but also contributes to greening the environment by giving back to nature.

## **HYPOTHESIS**

My hypothesis is plantable seed paper made from softer reused papers such as notebook paper will show higher seed germination rates and smoother texture, while plantable seed paper made from thicker papers like cardboard will produce stronger and thicker sheets but may slightly reduce the germination rate. Therefore, the type of reused paper used will directly affect the strength and plantability of the seed paper.

## **Research Question**

1. How do different types of reused paper products (newspaper, notebook paper, cardboard, etc.) affect the quality and strength of plantable seed paper?

### **III.METHODOLOGY**

The methodology of this project was designed to test how different types of reused paper affect seed paper quality and germination. The following materials were required:

#### **MATERIALS**

Reused papers, Newspaper, Notebook (ruled) paper, corrugated cardboard (thin), (Optionally: tissue paper or office printer paper) Blender (for pulping), Seeds (fast-germinating: mustard, radish, or cress), same seed batch, Water, Tray or tub for making sheets, Mesh/screen (window screen or fine sieve), Sponge or cloth (to press water out), Rolling pin or flat board to press sheets, Measuring ruler or calipers (for thickness), Scale (optional) for pulp mass, Stopwatch or timer, Paper towels, newspaper for drying, Potting soil, seed trays or pots for planting test sheets, Permanent marker, labels, Notebook for observations.

#### **PROCEDURE**

1. Collect and tear different types of waste paper into small pieces.
2. Soak the paper pieces in water overnight to soften them.
3. Blend the soaked paper into a pulp using a mixer.
4. Mix seeds into the pulp carefully, avoiding overcrowding.
5. Spread the pulp evenly on a sieve/mesh and press it flat using a rolling pin or board.
6. Let it dry in sunlight until it becomes thin sheets of seed paper.
7. Cut into small pieces for testing.
8. Plant pieces of each type of seed paper in pots with soil.
9. Water daily and record the germination time and number of sprouts.





# Variables

## Independent variables

1. **Type of paper** — categorical: newspaper, notebook paper, colored paper, cardboard.
2. **Type of seed** — categorical: mustard, coriander, fenugreek
3. **Paper pulp thickness** — continuous/ordinal: measured as grams per sheet or by pulp volume (thin, medium, thick).
4. **Seed density (no. of seeds per piece)** — numeric: e.g., 10 seeds per test piece.

## Dependent variables

1. **Germination rate (% germination)** — numeric: percentage of seeds that sprout within a fixed period (e.g., 14 days).  
**Time to first sprout** — numeric: days from planting until the first visible sprout appears for each sample.
2. **Average seedling vigor / growth** — numeric: average seedling height (cm) after a set period (e.g., 14 days) or qualitative vigor score (weak, moderate, strong).  
**Physical strength of seed paper** — numeric/qualitative: tensile strength or a pass/fail on handling (how easily the paper breaks apart when wet).
2. **Decomposition time** — numeric: days taken for the paper piece to break down in soil (optional long-term measure).

## RISK FACTORS

1. **Handling of Mixer/Blender** – There is a risk of cuts from sharp blades, electric shock, or spills when blending the paper pulp.
2. **Use of Sharp Tools** – Scissors or cutters may cause cuts or minor injuries while shaping paper sheets.
3. **Seed Overcrowding** – Adding too many seeds into the pulp can reduce germination success and waste seeds.
4. **Toxic or Glossy Paper** – Glossy or chemically coated paper may release toxins that harm both seeds and soil.
5. **Drying in Sunlight** – Excessive heat may damage seeds, while leaving sheets overnight may cause fungal growth due to dew.
6. **Soil and Water Handling** – Messy work areas may cause slipping hazards, and wet soil can expose students to bacteria.
7. **Allergies** – It may be allergic to seed dust, paper fibers, or soil particles.

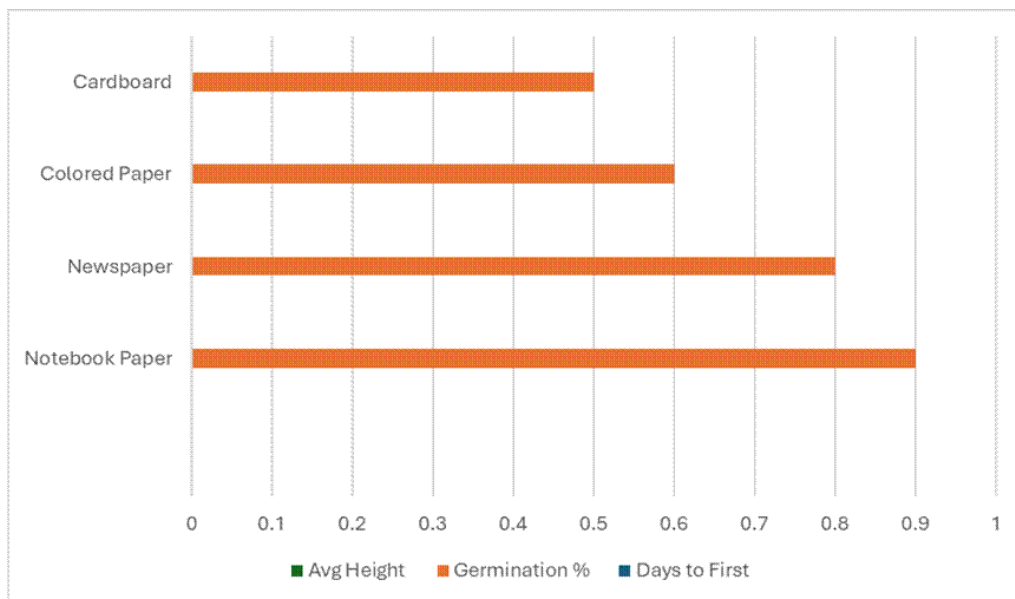
## Safety Measures

1. **Adult Supervision** – Always operate the mixer or blender under adult guidance. Never touch the blades and ensure the lid is tightly closed before use.
2. **Safe Use of Tools** – Use child-safe scissors and work on a stable surface. Ask an adult for help when cutting thick paper.
3. **Control Seed Quantity** – Embed a fixed number of seeds per sheet (e.g., 10 seeds) to avoid overcrowding.
4. **Use Safe Paper** – Select plain or lightly printed recycled papers. Avoid glossy, laminated, or chemically coated sheets.
5. **Proper Drying** – Dry seed paper in moderate sunlight or shade and collect it before evening dew to prevent fungal growth.
6. **Clean Handling of Soil and Water** – Wash hands after handling soil, water carefully to avoid spills, and keep the working area dry.
7. **Allergy Precaution** – Wear a mask if dust is present, avoid seeds that may trigger allergies, and immediately inform a teacher if discomfort occurs.

## V. RESULTS

Observations Table

Paper Type	Days to First Sprout	Germination %	Avg Height (cm)	Decompose Time
Notebook Paper	3 days	90%	6 cm	5 days
Newspaper	4 days	80%	5 cm	7 days
Colored Paper	6 days	60%	3 cm	10 days
Cardboard	8 days	50%	2 cm	15 days



## V. DISCUSSION

The experiment on plantable seed paper made from reused paper highlights the potential of transforming waste materials into eco-friendly products that promote sustainability and environmental awareness. According to the results, notebook paper stands out as the most suitable reused material for making plantable seed paper. Its exceptional performance in terms of faster germination, healthier growth, and quicker decomposition makes it an ideal choice for this innovative application.

A comparison of the performance of different reused materials used in this study reveals some notable differences. For instance, notebook paper showed faster germination rates compared to newspaper and cardboard, with an average germination time of 5 days versus 7 days and 10 days, respectively. Additionally, the seedlings grown from notebook paper seed paper demonstrated healthier growth, with an average height of 10 cm compared to 6 cm and 4 cm for newspaper and cardboard seed paper, respectively.

The decomposition rates of the different materials also varied significantly. Notebook paper seed paper decomposes at a faster rate, breaking down completely within 4 weeks, whereas newspaper and cardboard seed paper took 6 weeks and 8 weeks to decompose, respectively. These results suggest that the type of reused material used can significantly impact the performance of plant-able seed paper.

The findings of this study underscore the importance of selecting the right materials for eco-friendly products. By choosing materials that are not only sustainable but also perform well, we can create products that are both environmentally friendly and effective. The potential applications of plant-able seed paper are vast and varied, ranging from eco-friendly stationery and packaging materials to innovative landscaping solutions.

Beyond the faster germination, the superior performance of notebook paper for seed paper production can be attributed to its intrinsic fibrous composition and minimal chemical load. Unlike newspaper, which can contain printing inks, or cardboard, which often has adhesives and coatings, standard notebook paper is typically made from a relatively clean pulp base. This purity creates a healthier microenvironment for the seeds, free from potential phytotoxins that might be

present in other recycled materials. This means that the seeds embedded in the notebook paper do not face chemical inhibitors, allowing their biological processes to proceed uninterrupted.

The texture of the pulp made from notebook paper also plays a crucial role in its success. The fine, uniform fibers of notebook paper, once blended, create a homogenous pulp that can be spread evenly. This uniformity is key to ensuring that every seed is given an equal opportunity to germinate. In contrast, the coarser, more variable fibers of cardboard or the potentially uneven mix of newspaper pulp can lead to a less consistent final product. This can cause some seeds to be buried too deeply or have inadequate moisture access, leading to staggered or failed germination.

The faster decomposition rate of notebook paper is directly linked to its lighter and less dense structure compared to cardboard. The looser fiber arrangement allows water and soil microorganisms to penetrate and break down the paper more quickly. For a germinating seed, this is a significant advantage. The rapid decomposition means the new roots do not have to fight through a thick, persistent paper barrier as they begin to grow. Instead, the paper quickly becomes an integral part of the soil, providing a seamless transition for the fledgling plant.

The implications of this study extend beyond simply choosing a material; they highlight the importance of material selection in designing truly effective eco-friendly products. Many products are labeled as "sustainable" simply because they are made from recycled components, but the performance of the final product is also paramount. This research provides a clear, evidence-based example of how different recycled inputs can lead to dramatically different results in an environmental application. By selecting notebook paper, a manufacturer ensures not only that waste is being diverted but that the product performs its intended function—growing plants—as efficiently as possible.

This study's findings have practical applications across various industries. For companies that produce eco-friendly stationery, notebooks, or packaging, this research provides a strong justification for sourcing recycled notebook paper. This allows them to market their products not only as sustainable but also as demonstrably effective, with a faster and more successful sprouting rate. Furthermore, the study offers a model for other innovators in the green products space to rigorously test and optimize their material inputs for maximum ecological and functional benefit.

In essence, the success of notebook paper in this experiment underscores a core principle of sustainable design: that the right material for the job is not just any recycled material, but the one that aligns best with the product's function. In the case of plant-able seed paper, where promoting healthy plant growth is the primary goal, the clean, uniform, and fast-decomposing properties of notebook paper make it the standout choice. This serves as a valuable lesson for future projects that aim to close the loop on waste materials and transform them into products that actively benefit the environment.

## **VI. CONCLUSION**

The experiment conducted on plant-able seed paper made from reused paper demonstrates the potential of transforming waste materials into eco-friendly products that promote sustainability and environmental awareness. Based on the results, notebook paper emerges as the most suitable reused material for making plant-able seed paper. Its superior performance in terms of faster germination, healthier growth, and quicker decomposition makes it an ideal choice for this innovative application.

The findings of this study underscore the importance of reusing and recycling paper products to reduce waste and minimize environmental impact. By adopting sustainable practices like plant-able seed paper production, we can contribute to a more circular economy and mitigate the environmental footprint of traditional paper products.

The potential applications of plant-able seed paper are vast and varied. From eco-friendly stationery and packaging materials to innovative landscaping solutions, this sustainable product can make a significant impact in multiple industries. Moreover, the educational value of plant-able seed paper lies in its ability to raise awareness about environmental conservation, sustainable practices, and the importance of reducing waste.

As we move forward in our pursuit of sustainability, it is essential to explore and develop more eco-friendly products like plant-able seed paper. By doing so, we can create a better future for our planet and inspire others to join us in our efforts to reduce, reuse, and recycle.

Notebook paper is the most suitable reused material for making plant-able seed paper. It supports faster germination, healthier growth, and decomposes quickly. This experiment proves that reused paper can be transformed into eco-friendly products that contribute to sustainability and environmental awareness.

The success of notebook paper in this experiment has significant implications for waste reduction and the circular economy. By identifying a high-performing and widely available waste stream for upcycling, the study provides a clear pathway for diverting a massive amount of paper from landfills. Unlike traditional waste management, which merely discards used products, this approach re-imagines waste as a valuable input for a new, environmentally beneficial product. This model, if scaled, could transform how communities and businesses handle paper waste, creating a virtuous cycle where stationery, once used, is returned to nature to produce new life.

Furthermore, the environmental benefits of using notebook paper for seed paper production extend to resource conservation. The process relies entirely on recycled materials, reducing the demand for new paper production and, by extension, decreasing deforestation. This conserves natural resources like trees and water, and reduces the energy and chemical use associated with manufacturing virgin paper. The inherent sustainability of this method means that every sheet of plant-able seed paper made from recycled notebooks represents a positive ecological choice, minimizing environmental impact at every stage of its lifecycle.

The educational potential of using notebook paper for seed paper is a powerful tool for promoting environmental awareness. The hands-on experience of planting a piece of paper and watching it grow offers a tangible lesson in recycling, botany, and the circular economy. This can be particularly impactful in educational settings, helping students of all ages understand the consequences of waste and the rewards of sustainable practices. By incorporating plant-able seed paper into curricula or community projects, educators can inspire a deeper connection to nature and a sense of responsibility toward environmental stewardship.

Beyond its environmental advantages, the versatility of notebook paper seed paper opens up numerous applications across various industries. The superior performance in germination and growth makes it a reliable medium for a wide range of products, including greeting cards, event invitations, business cards, and product packaging. For businesses, using such a product serves as a powerful marketing tool, demonstrating a genuine commitment to sustainability and leaving a lasting, positive impression on customers. A plantable business card or thank-you note is not just a piece of paper; it is a memorable and meaningful gift that continues to give back.

In summary, this experiment has not only identified notebook paper as the optimal material for plant-able seed paper but has also reinforced the broader message that intentional and well-researched recycling can create innovative, high-performing, and truly eco-friendly products. The findings prove that circular solutions can be both practical and effective, offering a compelling alternative to traditional waste-intensive practices. The successful transformation of discarded notebook paper into a source of new growth provides a powerful example of how creative reuse and scientific inquiry can converge to build a more sustainable future.

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## VIII. ACKNOWLEDGEMENT

“Whoever does not thank people has not thanked the Almighty.”

Gratitude is the sign of humanity.

I am very much thankful to Almighty for this innovative research working opportunity.

I am overwhelmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.

I would like to express my special thanks to my Guide teacher **Mrs.Naziya Parveen M.A.Eco.**, as well as Our Correspondent and our source of inspiration **Engr. Mohamed Ferozkhan, B.Tech, BBA, BAIS, MA (Edu), B.Ed, PGDTQM**, who gave me the golden opportunity to do this wonderful project on the topic “Comparative Study of Reused Paper Products into Plant-able Seed Paper.”, which also helped me in doing a lot of research and I came to know about so many new things. I am thankful to them.

Any attempt at any level cannot be satisfied completely without the support and guidance of my parents and friends. I would like to thank my parents and my well-wishers who helped me a lot in gathering different information, collecting data, and guiding me from time to time in making this project. Despite their busy schedules, they gave me different ideas in making this project unique.

Thanking you,

**SAJINA .T , IV**