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Eco Printing On Natural Fabrics Using Pine Tree Leaves: A Study Of Mordant Influence On Cotton And Silk

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Abstract

Eco printing is a sustainable surface embellishment technique that involves the direct transfer of plant shapes, structures, and sometimes pigments onto textiles through contact and heat. This study explores the eco-printing potential of pine tree leaves on cotton and silk fabrics, pre-treated with four different mordants: alum, copper sulphate, katha, and harda. The experiment evaluates how each mordant affects the clarity, contrast, and aesthetics of the resist-based prints. The results highlight the unique visual impact of each mordant–fabric combination, with silk generally producing clearer and more refined prints than cotton. The study underscores the role of mordants in influencing eco-print outcomes and provides insights into plant-based textile surface design.

Keywords: Eco printing, pine leaves, natural dyes, mordants, cotton, silk, sustainable textiles, contact printing.

1. Introduction

The increasing demand for environmentally friendly textile production methods has led to the resurgence of natural dyeing and surface embellishment practices, including eco printing. Eco printing involves placing plant materials on fabric, bundling, and steaming or boiling the textile to transfer plant impressions onto the fabric. Unlike conventional dyeing, which extracts and applies color, eco printing emphasizes the direct contact of botanical matter, often relying on plant shapes and the interaction of mordants with plant-derived compounds.Pine tree leaves (Pinus spp.), although not traditionally recognized for dye extraction, offer a unique linear and vein-like structure that can create aesthetically appealing resist impressions. This study investigates how pine leaves behave in eco printing when applied to two natural fabrics—cotton and silk—pre-mordanted with alum, copper sulphate, katha, and harda.

2. Materials and Methods

2.1 Materials

Fabrics:
- 100% Cotton
- 100% Mulberry Silk

Plant Material:
- Freshly collected Pine tree leaves (Pinus species)

Mordants Used:
- Alum (Potassium aluminum sulfate)
- Copper sulphate
- Katha (Catechu extract)
- Harda (Terminalia chebula)

2.2 Mordanting Procedure

All fabrics were first scoured to remove impurities. Separate fabric samples were then mordanted using aqueous solutions of alum, copper sulphate, katha, and harda respectively. Each mordanting process involved soaking the fabric in a 10% w/v solution for 1 hour, followed by drying before printing.

2.3 Eco Printing Technique

Pine leaves were arranged on the pre-mordanted fabrics and tightly bundled around iron rods. The bundles were steamed for 1.5 to 2 hours. Once cooled, fabrics were unwrapped, allowed to rest for 24 hours for oxidation, then rinsed in cold water and air-dried. No external dye or blanket layer was used in this series.

3. Results and Discussion

The prints created by pine tree leaves on both cotton and silk were primarily resist-based.

3.1 General Comparison Table

Mordant	Cotton – Result Summary	Silk – Result Summary
Alum	Pale background, faint leaf outlines	Soft golden hue, clearer and delicate prints
Copper Sulphate	Dark green to brown background, sharp resist	Bold contrast, dark background with clear leaf voids
Katha	Warm tan-brown base, diffuse outlines	Earthy beige tone, subdued yet elegant print
Harda	Grayish tint, moderate print clarity	Cool-toned background, sharp leaf silhouettes

3.2 Detailed Analysis by Mordant

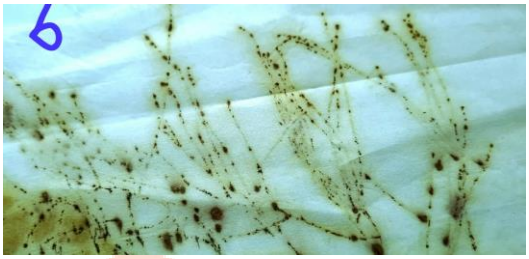
3.2.1 Alum Mordant on Cotton and Silk

Alum-mordanted samples produced the lightest and most subtle outcomes in this study.

On silk, the resist prints were fine and delicate, appearing against a soft yellowish background. The pine leaf outlines were graceful; showing refined details due to silk's tight weave and protein composition. The overall print had a golden tint that added visual warmth and elegance.

On cotton, the prints were significantly lighter with minimal contrast. Leaf impressions were faint, and the background remained mostly off-white with a light yellow hue. The overall appearance was soft and gentle, ideal for understated fabric design.

Silk Sample



Cotton sample

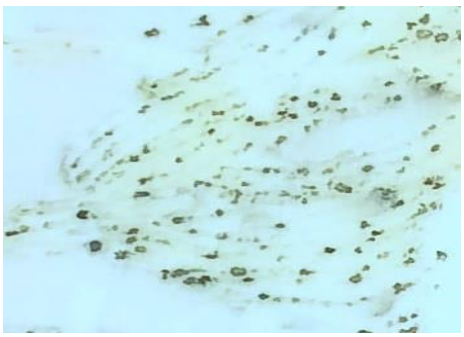
3.2.2 Copper Sulphate Mordant on Cotton and Silk

Copper sulphate mordant produced the most dramatic contrast among all samples.

On silk, the background developed into a dark olive or greenish-brown tone. Pine leaf structures emerged as striking negative images—crisp, clean, and highly visible. This high contrast made the prints bold and defined, enhancing the natural symmetry of the leaves.

On cotton, the background turned darker, with sharp leaf outlines. The resist effect was clear, and although slightly less refined than on silk, the print retained strong visual appeal. Copper's role as both a mordant and a color intensifier contributed to the strong definition.

Silk Sample



Cotton sample

3.2.3 Harda Mordant on Cotton and Silk

Harda mordant, known for its high tannin content, created medium-contrast results with a slightly cool undertone. On silk, the prints had a soft grayish to olive cast. Leaf structures appeared clearly with fine vein detail, offering a balance between subtlety and sharpness. The cool tone of the background provided a neutral contrast that enhanced the natural textures of the pine leaves.

On cotton, the background took on a grayish-brown hue. The leaf impressions were visible but not deeply defined. The overall aesthetic was vintage and slightly faded, appealing for use in heritage-inspired or earth-toned textile designs.

Silk Sample Cotton sample

3.2.4 Katha Mordant on Cotton and Silk

The fabrics mordanted with katha exhibited a warm and earthy tone, reflecting the tannin-rich nature of catechu. On silk, the background developed into subtle beige to light brown hue. The pine leaf impressions appeared soft and abstract, creating a delicate contrast. The resist effect was visible but not sharply outlined, giving the print a painterly or watercolor-like appearance. The smooth, protein-based texture of silk enhanced the fluid blending of natural tones, resulting in a graceful and organic aesthetic.

On cotton, the results were more muted. The background adopted a warm tan shade, while the pine leaf shapes remained faint and diffuse. The resist outlines were less defined compared to silk, likely due to cotton's more absorbent structure. Despite the low contrast, the overall visual effect was rustic and harmonious, suitable for applications where subtlety and earthiness are desired.

Silk Sample Cotton sample

3.3 Wash and Light Fastness Results

Standard tests were conducted to evaluate the wash and light fastness of the eco prints. The results are summarized below on a scale of 1 (poor) to 5 (excellent).

Mordant	Wash Fastness (Silk / Cotton)	Light Fastness (Silk / Cotton)
Alum	4	7 / 6
Copper Sulphate	4 / 3	7 / 6
Katha	4	7
Harda	4	6

4. Conclusion

This study demonstrates the aesthetic potential of pine tree leaves for eco printing on natural fabrics. While the leaves themselves did not release pigment, they produced compelling resist-based patterns. Silk, due to its protein structure, consistently offered finer and clearer prints compared to cotton. Among mordants, copper sulphate produced the most striking results, while katha and harda created softer, more rustic impressions. The choice of mordant and fabric significantly influences the artistic and technical outcome of eco printing and should be selected based on the intended visual and product application.

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