

The Great 2020 Dyeing Fade Test



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Summary

This project tested the colorfastness of weld, madder, cochineal, and indigo alone and in combination. These dyes were tested on linen, spun wool, wool locks, silk thread, and silk fabric. The time length of the tests lasted from one week to one year.

This material is also available on [my SCA blog](#). You can read [part 1 here](#) and [part 2 here](#).

How to Read This Document

1. Treat each section as a different part of the display.
2. Read non-linearly! Start with the section you find most interesting, then move on to another section that interests you or will give context to the previous section. To quickly move between sections, the Contents page links directly to each section.
3. Want to chat? Email me, find me on Facebook, and/or come to “[Meet the Display Artists](#)” at 3:00 PM during Kingdom Arts and Sciences Festival on March 22.

Background

After taking a class on natural dyeing using different yellows and indigo in May 2019 at Maryland Sheep and Wool with Jackie Ottino, I decided it was finally time to dye a Romney fleece I bought in 2017. However, I wanted to test sun-colorfastness first, as I had noticed some garments that I dyed with commercial dyes were fading significantly after 2 years of SCA wear and washing. In addition, the fleece had some canary stains (unremovable yellow stains affecting the color and texture of the tips of each lock), and I wanted to see how the dye took to the white roots versus the yellow tips. Thus, this project was conceived!

Materials

For this project, I used locks and handspun wool from my Romney fleece. I also pulled commercial linen fabric, silk fabric, and silk thread to accompany the wool. Overall, my materials were:

- Wool (Romney fleece)
 - Handspun (spindle-spun)
 - Full locks
 - Canary-stained tips
 - White roots
 - Washed locks
- Linen purchased from [Dharma Trading](#)
- Silk
 - Fabric purchased from [Dharma Trading](#)
 - 2/20 thread purchased from [Eowyn de Wever](#)

For the wool, I decided to dye both locks and spun yarn. The majority of the yarn was handspun worsted-style from full locks. However, I spun some yarn woollen-style out of just the white roots and just out of the yellow tips, so that I could test how dye was taken up and lasted on the canary stains versus the unstained roots.

Dyes & Dye Combinations

I chose weld and madder because, with woad, they formed the great triumvirate of medieval dyes. However, as a beginner dyer, I chose to use indigo instead of woad, as woad and indigo are chemically indistinguishable but indigo is more beginner friendly. I also decided to dye with cochineal, as European species were available during the Middle Ages; however, I used American cochineal, as this is more readily accessible and environmentally responsible. All dyes except indigo were purchased from Jackie Ottino at the Maryland Sheep and Wool Festival; indigo was dyed at a friend's house from a commercial kit with reduced crystals.

I dyed every material alone and in the following combinations:

Dye Combinations				
	Weld	Madder	Cochineal	Indigo
Weld	X	X	X	X
Madder		X		X
Cochineal			X	X
Indigo				X

Fiber Preparation

The fleece was originally processed lock-by-lock with hot water and Dawn detergent. I scoured the commercial samples with Synthrapol in an enameled pot that had a dent exposing some of the steel. My water was pH neutral throughout the process.

Timing

When I decided that I was testing sun-fading, I decided I wanted to do it right: over multiple periods of time. Thus, when I put together my goods for dyeing, I pulled enough to have sun-testing lots of each combination for these times, centering roughly around midsummer:

- One week: June 19 – June 26
- One month: June 1 – June 30
- Three months: April 26 – July 26
- Six months: March 16 – September 16
- One year: January 1 – December 31

All materials and dyes were exposed for each of these time periods, except for the yarn spun from canary-stained tips and white roots. These were only exposed for three months. I also kept a control swatch of each color and material in a dark closet. All swatches were put in a south-east facing window for the duration.



Dye Recipes & Process

Unless otherwise noted, all items in this experiment were dyed in an enameled pot with a dent (exposing a small surface area of steel) on a gas stove. A canning rack was included with the weld and madder, but after it left marks on some of the items during the madder dye, it was removed.

Mordant

All goods were mordanted in alum (aluminum sulfate) at 12% WOG (weight of goods), cold-soaked for ~23 hours in a plastic tub.

Weld

Dye: 3% WOG of a powdered extract

Process: Weld was dissolved in hot water and then poured into the dye bath. The dyegoods were placed in the bath at 3:34 PM at 81F. I raised the temperature to 180F on medium-high heat over one hour, then turned off and left to cool. Once it was cool, I rinsed the goods in cool tap water.



Weld dyeing in progress

Madder

Dye: 20% WOG of ground root (this ended up too weak for my taste – see “Takeaways”)

Process: The dyestuffs were placed in the pot with the dyegoods at 7:39 PM in tap-hot water (118F) on medium-high heat. I raised the temperature to 180F over 40 minutes, then left to cool overnight. The goods were removed at 10:14 AM but were too orange for my taste, so I added household ammonia to get a pH of 10. I re-added the goods and reheated them to 170F. I then turned the heat off and left in dye for over 24 hours. The goods were rinsed in cool tap water.

Cochineal

Dye: 100% WOG (this was definitely too strong – see “Takeaways”)

Process: The cochineal was hand-ground and soaked in a glass vessel overnight (with a note of “Don’t drink the bug-juice in the stein!”). The dye was then strained through an old tea sock, which was tied up with a pipe cleaner and put in the dye pot with the strained liquid and additional water. This concoction was put on high heat until simmering, then held at simmering for 20 minutes. The bug packet was then squeezed and removed, and the pot was filled further with hand-hot water. The goods were put in at 120F on medium-high heat. The heat was raised to 160F, then 1 tsp cream of tartar was added and stirred. I continued raising the heat to 180F, turned the heat to medium-low, and left it covered for 20 minutes. I then turned off the heat and left it for 75 minutes. I put in additional goods to absorb dye (primarily spare roving), raised the temperature back up to 180F, then immediately turned it off and left it to cool for 5 hours. The goods were cooled and then rinsed.



Cochineal dyeing in progress

Indigo

The indigo was done at a dyeing day run by [Gusukuma Kame](#). The indigo was pre-reduced crystals with tap-hot water, dyed outside. All goods were soaked in cool water, dipped once in the indigo, hung up to drip, and then rinsed in citric acid. Because I was still getting a lot of crocking after the citric acid rinse, I also did an extensive rinse (possibly an over-rinse) in Synthrapol.

Results & Analysis by Dye

Weld



The initial weld dye achieved different depths on the different materials, with just a hint of green undertone. However, this green undertone faded within a week, so if that is something people dislike about weld, they can intentionally eliminate it with one week of sun exposure. It seemed like weld faded quite significantly, but when compared with the original materials (see materials below), there is still a cream tint.

Madder



So... 20% madder does not last. In person, it was the barest buffs/blush pinks on both wools and silk fabric at the end, and it's nearly completely gone on linen by six months. Anything that I do with madder that I want to last will either need a greater concentration of dye *or* will need to only have limited sunlight.

Weld/Madder

WELD/MADDER

alum mordant
weld @ 3% / madder @ 20%

	CONTROL	1 WEEK	1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
LINEN						
SPUN WOOL						
WOOL LOCK						
SILK THREAD						
SILK FABRIC						

Wow did this one fade on linen! When compared with the madder below and weld above, it's surprising that this combination lasted longer on the other materials. However, the multiple layers of dye may have protected each other while also fading at similar rates, with richer tones achieved. This combination also grew on me as it faded.

Cochineal



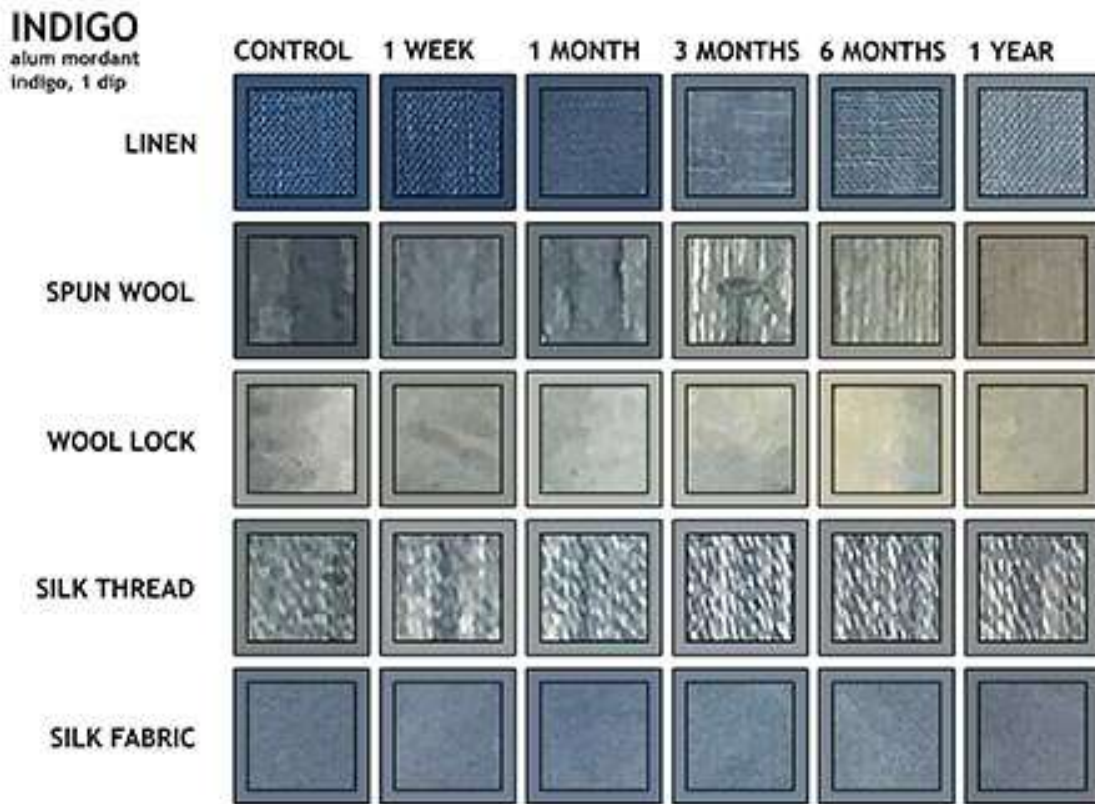
Despite the richness and intensity of the dye bath, cochineal faded significantly on both wools and the linen, almost fully disappearing. However, the cochineal on both silks faded at about the same rate.

Weld/Cochineal



While the concentration of cochineal completely overpowered the weld, like the weld/madder combination, this combination gave the dye greater staying power. That said, I found it quite odd that the cochineal nearly fully disappeared from the wool lock but remained with decent saturation on the spun wool. Perhaps the compressed nature of the yarn (with cochineal saturating it) protected the dye more from the sun, where the spread-out nature of the wool lock did not. On the bright side, this combination lasted well on most materials!

Indigo



Indigo lasted well on all the bases, but particularly well on the silk and linen; there was almost no change on the silk fabric, and the change on the linen was visible but not significant. I was surprised that indigo faded more on both wools, so I would be interested to see how greatly it would fade if I dipped any of these materials more than once in the indigo. Since indigo sits on top of fibers instead of being absorbed by them, this dye would be an easy one to use regularly and top up as needed as fading happens.

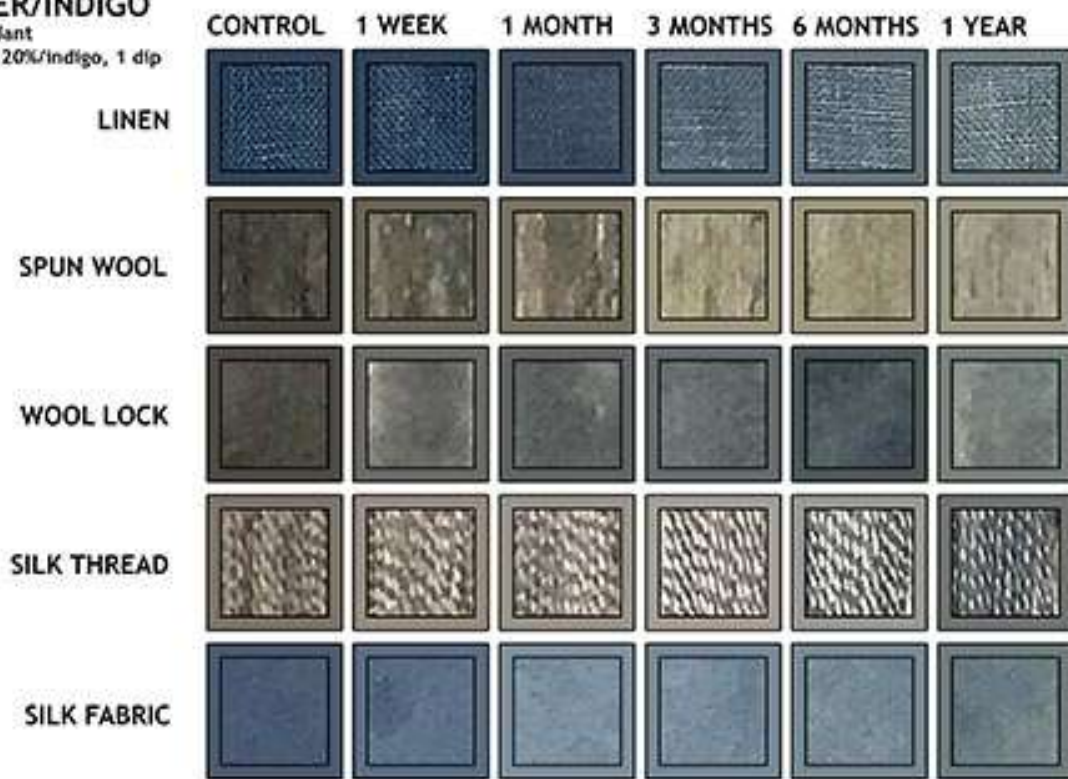
Weld/Indigo



Weld/indigo is one of my favorite color combinations, so I was sad to see how quickly the weld faded. In all cases, the weld was pretty much gone by the three month mark; however, for linen it was pretty much gone after one week. Indeed, the final colors for all materials are pretty much the same as the plain indigo swatches.

Madder/Indigo

MADDER/INDIGO
alum mordant
madder @ 20%/indigo, 1 dip



I'm still intrigued by how weirdly mushroom-colored this combination ended up on both wools and the silk thread, while the indigo completely overpowered the madder on the silk fabric and linen. That said, this combination had a much more gradual fade than some of the other dyes.

Cochineal/Indigo



The indigo took better to the linen and the wool lock than silk (possibly the cochineal being overpowering again); the cochineal also seemed to fade faster on the linen and wool lock. However, the combination seemed to fade evenly in both silks and the spun wool, though the spun wool faded the greatest out of all the materials.

Results & Analysis by Material

Linen



Unsurprisingly, because my mordant wasn't suited to plant fibers, the dyes did not last well on linen. Indigo lasted pretty well, but pretty much every other color is gone by one year. There is also a distinct jump in fading between one and three months, but less so between three months and six months.

Spun Wool

SPUN WOOL	CONTROL	1 WEEK	1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
WELD alum mordant weld powder @ 3%						
WELD/MADDER alum mordant weld @ 3% madder overdyer @ 20%						
MADDER alum mordant madder root @ 20%						
WELD/COCHINEAL alum mordant weld @ 3% cochineal @ 12%						
COCHINEAL alum mordant cochineal (ground) @ 12%						
INDIGO alum mordant indigo, 1 dip citric acid rinse						
WELD/INDIGO alum mordant weld @ 3% indigo, 1 dip citric acid rinse						
MADDER/INDIGO alum mordant madder @ 20% indigo, 1 dip citric acid rinse						
COCHINEAL/INDIGO alum mordant cochineal @ 12% indigo, 1 dip citric acid rinse						
UNDYED SPUN WOOL						


On the spun wool, the weld/cochineal and weld/madder combinations lasted the best. There is also a distinct change between one month and three months on this material, but less so with three months to six months.

Wool Lock

WOOL LOCK	CONTROL	1 WEEK	1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
WELD alum mordant weld powder @ 3%						
WELD/MADDER alum mordant weld @ 3% madder overdyer @ 20%						
MADDER alum mordant madder root @ 20%						
WELD/COCHINEAL alum mordant weld @ 3% cochineal @ 12%						
COCHINEAL alum mordant cochineal (ground) @ 12%						
INDIGO alum mordant indigo, 1 dip citric acid rinse						
WELD/INDIGO alum mordant weld @ 3% indigo, 1 dip citric acid rinse						
MADDER/INDIGO alum mordant madder @ 20% indigo, 1 dip citric acid rinse						
COCHINEAL/INDIGO alum mordant cochineal @ 12% indigo, 1 dip citric acid rinse						
UNDYED WOOL LOCK						
	Unwashed	Washed				

Unsurprisingly, the wool lock faded similarly to the spun wool. When reviewing these locks, it is important to remember that the full locks have canary stains (yellowing at the tips). This stain can be seen in the swatch of the undyed, washed lock, which I sized so that the difference between the white and yellow part of the lock was visible.

Silk Thread

SILK THREAD	CONTROL	1 WEEK	1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
WELD alum mordant weld powder @ 3%						
WELD/MADDER alum mordant weld @ 3% madder overdye @ 20%						
MADDER alum mordant madder root @ 20%						
WELD/COCHINEAL alum mordant weld @ 3% cochineal @ 12%						
COCHINEAL alum mordant cochineal (ground) @ 12%						
INDIGO alum mordant indigo, 1 dip citric acid rinse						
WELD/INDIGO alum mordant weld @ 3% indigo, 1 dip citric acid rinse						
MADDER/INDIGO alum mordant madder @ 20% indigo, 1 dip citric acid rinse						
COCHINEAL/INDIGO alum mordant cochineal @ 12% indigo, 1 dip citric acid rinse						
UNDYED SILK THREAD						

Yup, this is why silk was so valuable throughout history. It's not just that the fabric feels luxurious — dye *lasts*. While there is fading after a year, it is far more saturated than any of the other materials. (Nota bene: the one-year weld swatch may not be perfectly accurate due to some photography issues). That said, if I used natural dyes for weaving trim, I'd plan to sew it on in a way that I can rip it off when it fades too much and flip it over.

Silk Fabric

SILK FABRIC	CONTROL	1 WEEK	1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
WELD alum mordant weld powder @ 3%						
WELD/MADDER alum mordant weld @ 3% madder overdyer @ 20%						
MADDER alum mordant madder root @ 20%						
WELD/COCHINEAL alum mordant weld @ 3% cochineal @ 12%						
COCHINEAL alum mordant cochineal (ground) @ 12%						
INDIGO alum mordant indigo, 1 dip citric acid rinse						
WELD/INDIGO alum mordant weld @ 3% indigo, 1 dip citric acid rinse						
MADDER/INDIGO alum mordant madder @ 20% indigo, 1 dip citric acid rinse						
COCHINEAL/INDIGO alum mordant cochineal @ 12% indigo, 1 dip citric acid rinse						
UNDYED SILK						

Excepting madder and weld, the dyes definitely lasted the longest on the silk fabric! I would happily dye a piece of silk clothing in any of these colors, knowing I could redye it after a few years of irregular usage.

Canary-Stained Locks

SPUN WOOL WHITE VS. YELLOW TIPS	CONTROL WHITE	CONTROL YELLOW	3 MONTHS WHITE	3 MONTHS YELLOW
WELD alum mordant weld powder @ 3%				
WELD/MADDER alum mordant weld @ 3% madder overdye @20%				
MADDER alum mordant madder root @ 20%				
WELD/COCHINEAL alum mordant weld @ 3% cochineal @ 12%				
COCHINEAL alum mordant cochineal (ground) @ 12%				
INDIGO alum mordant indigo, 1 dip citric acid rinse				
WELD/INDIGO alum mordant weld @ 3% indigo, 1 dip citric acid rinse				
MADDER/INDIGO alum mordant madder @ 20% indigo, 1 dip citric acid rinse				
COCHINEAL/INDIGO alum mordant cochineal @ 12% indigo, 1 dip citric acid rinse				
UNDYED SPUN WOOL TIPS				

Finally, we come to the canary-stained test! This whole year-long project launched from wanting to see if dye would stick to the canary stains for a significant time, so this must be included. Surprise: it does! After three months, there's no significant difference in fading between the yellow tips and the white roots. In fact, the dye lasts a little bit better on the

yellow tips, even though it may take the initial dye less well. Even better, the undyed swatches indicate that the yellow bleaches out of the tips pretty well after three months!

Takeaways

This was a long and complex project, so I learned a lot from it! Regarding materials, I liked the results of dyeing the wool and silk the best, as the color was richest on these materials and weakest on the linen. This was expected — protein fibers take dye better than cellulose fibers, and I didn't use the best mordant for cellulose fibers. I generally prefer working with protein fibers anyway, but if I explore more cellulose fiber dyeing in the future, I may repeat this project with appropriate mordants.

The effects with the wool were particularly interesting for me, as the Romney fleece was the impetus for this project. I was intrigued to see that the wool locks took the dye more evenly than thread/yarn and fabric (thus the saying, “dyed in the wool!”); however, the yellow tips on the wool locks absorb the dye less evenly. The most significant example of this was on the cochineal/indigo locks: the main body of the lock was purple, but the tip remained deep magenta!

Regarding the dyes, weld rapidly became my favorite; it's reliable and consistent, and I love the garish yellow it gives. For the madder, I should have used 50-100% WOG with ammonia immediately added to get a stronger red, as my initial recipe gave me a moderate orange; a stronger red may have also faded more slowly. I have since [started experimenting with madder, exhaust, and pH](#). For cochineal, I absolutely adore the color, but I went completely overkill on the amount of dye. I fully overpowered the weld overdye, but I was pleased to see a subtle difference that affected the fade test. Finally, because the indigo was crocking significantly, I rinsed all the goods in Synthrapol after the original citric acid rinse; however, I think I overdid the Synthrapol rinse. More indigo experiments will be necessary to find the right balance.

With the overall fade test, I was unsurprised with how the different materials both took the dye and how the dye did or did not last, as it aligned with everything I had read. However, I was surprised to see that the dye seemed to fade faster on the wool locks than the spun wool; I wonder if the compression of the fibers in the spun wool protected the dye from the sun better than the spread-out locks did. I was happily surprised to see that the dye lasted exceptionally well on the canary-stained wool; I was also pleased to see that the undyed canary stains bleached out well.

Finally, the most fun discovery was that when you iron cochineal, *it turns lavender* (until it cools off and returns to the original color)!

This project has also led me to consider how to apply this knowledge. Overall, anything that I dye with natural dyes will need to be protected from the sun, used rarely, or redyed regularly. Silk will be better for embroidery and tablet or inkle weaving on garments, as it will last longer; any embroidery or weaving I want to do with wool will need greater protection. Hand-dyed woven trim may be a good use, as trim can be cut off and flipped over. However, even if I wear or display hand-dyed items every weekend for a full year, it will still take three years for it to reach the same fade level of this fade test. For this reason, I will focus my natural dyeing on particularly precious items that will see less regular use.

Dye Book Video & Links

Photographing color is *hard*. While I did my best to control the lighting for the swatches and developed a replicable way to photograph (white background, pitch black room, and ring light!), colors change in different lighting, and there is no good way to replicate that in photographs. However, film can capture some of that, so I have created a video so that you can see the full dye book live. This video was filmed on a rainy day with one incandescent light off to the right of the video, not overhead. You can [watch it on YouTube here](#).

Want to recreate these colors in digital art? The borders around each swatch are an averaged color of each swatch! [Download a PDF of all the dye swatches here](#) and use a color-picker to choose the color in your preferred mode, and let me know what you do with it!

This material is also available on [my SCA blog](#). You can read [part 1 here](#) and [part 2 here](#). In 2020, I also [started experimenting with madder, exhaust, and pH](#).

Classes Taught FROM This Project

Let's Get Faded: Natural Dyes and Sunlight

Winterkingdom, Barony of Northkeep, Ansteorra, Jan. 2021

Dyeing without Dying: An Introduction to Natural Dyes

Fiber, Fabric, & Fun XVIII, Shire of Abhainn Ciach Ghlais, Æthelmarc, Nov. 2020

University of Atlantia, Sep. 2020



Control cards prepared for storage



Fade cards prepared to go in the window

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