

Dyeing EZ Dye Cotton

Eileen Hallman



Cover photo: [Dyer's Delight](#) Cotton as weft on a white untreated cotton warp. Fabric tie-dyed with Procion MX.

Introduction

Scouring

Dyeing

Fiber Reactive/Procion MX

Acid Dyes

Direct Dyes

Natural Dyes

Introduction

E-Z Dye Cotton has been treated allow the fiber to accept dyes more readily than the traditional mercerization using a less caustic method. The treatment is permanent, and can not be removed by washing. The fiber is treated with a fugitive tint so that it can be distinguished from untreated cotton, and must be scoured prior to dyeing.

Dyes which can be used with this cotton include acid dyes in addition to the fiber reactive and direct dyes commonly used for cotton. It should be noted that Kool-Aid is an acid dye.

The treatment was developed to reduce the environmental impact of industrial dyeing. In dyeing large quantities of cotton fiber, yarn, or fabric, large quantities of water, salt, and soda ash are required, and these are not exhausted in the process. Residual amounts in the waste water must be removed before discharge, which is an additional expense beyond the dyeing itself.

The treatment causes the fiber to attract dye without the use of auxiliaries such as salt or washing soda. Because of this attraction, more dye is taken up than in untreated cotton, and very little dye remains on the fiber that is not permanently attached. Careful use can allow industrial dyers to introduce just enough dye so that the dyebath is exhausted. No auxiliaries are needed, so there is essentially nothing in the waste water. Additionally, because so much dye remains attached, less rinsing is required, resulting in less water use.

Note that although the auxiliaries are not necessary; in most cases using them will not affect the process.

Less water, less dyestuff, and no auxiliaries is a recipe for lowered cost as well as greatly decreased environmental impact.

Scouring

The fiber must be either scoured or laundered to wet it out and to remove the fugitive tint.

I have laundered fabric in the washing machine with the water set to the highest level; the highest setting of most water heaters is about 140°F. This is sufficient to remove the tint. I have had the water set to a lower temperature and the tint was not completely removed, but it did not seem to affect the dye take-up.

To scour it, simmer in water with a little detergent and washing soda to bring the bath to a pH of 10. Scouring removes not only the natural waxes and the sizes that are used to make yarn and fabric, but the natural pectins and

lignins as well. Laundering does not necessarily remove the natural pectins and lignins, but it does remove the waxes and sizes.

Dyeing

The generic instructions: dye powder plus warm water, enter fiber, move fiber around in the dye liquor for a few minutes, remove, rinse once, dry.

High heat is not required. The water temperature should be at least 80°F, and as with any chemical reaction, the speed of the reaction increases with temperature. The strike is very fast, so level dyeing is better achieved at lower temperatures. If you do microwave dyeing, the high heat will not harm the fiber or the dye process, it just may not be necessary.

Rinsing is minimal; usually one rinse is all that is required.

Industry uses this treated cotton in a technique known as differential dyeing. Mixed in a fabric with untreated cotton, the treated will accept the dye and the untreated will not. This offers an additional cost savings to producers of fabrics, as they can produce the fabric and the buyer is then responsible for the color. It helps the buyer because the fabric can be piece dyed in the season's colors with little overrun.

This same strategy is a boon to handweavers as well, especially those who use seasonal colors for production weaving.

Fiber Reactive/Procion MX

I first tried fiber reactive dyes, because I could borrow some from a friend.

I wove some squares in 1/3 vs. 3/1 twill based on profile #65 from John Landes, *A Book of Patterns for Hand-Weaving*.

For warp I used 18/2 untreated cotton sett at 32 epi, 18" wide, 576 ends.

I spun the weft, which was the [Dyer's Delight](#) EZ Dye cotton. Draw-in on the loom was 1.375", because I weave with singles and did not use a temple.

I wove some yardage to cut into test strips by just repeating the section with the longest span of uninterrupted weft color. I also wove three repeats of the pattern to make three squares.

I cut these off and laundered them in the washing machine with hot water and detergent (I use one without optical brighteners). I have my water heater set about 1/3 of the way between Warm and Hot, and the temperature is about 120°F.



I prepared three dyebaths, Procion MX turquoise, fuchsia, and golden yellow. I used rainwater and because it was very cold I heated it to about 100°F. I used nothing but the water and a tiny bit of dye powder, maybe 1/8 tsp in about a half gallon bowl. It only took minutes at this temperature; it would take longer at cooler temperatures.

I tied in two places and dyed the first square with Procion MX fuchsia. I then removed the ties and immersed the piece in turquoise. The turquoise overdyed the fuchsia to give a medium lavender/purple. The white warp was not affected.

The second square I tied and dyed Procion MX golden yellow, then removed the first ties and tied two more on the yellow. Then I immersed in turquoise to get turquoise, yellow, and the green from over dyeing. The white warp was not affected.

I did a third piece with all three colors.

I rinsed the cloths between dips; the rinse water was clear for the fuchsia and the yellow, but some of the turquoise rinsed out of the first rinse. The second turquoise rinse was clear.

I had put on a long warp, so I tied it back up and wove some other pieces in the pattern with a different weft yarn for a separate project, and then some more yardage to cut into test strips. I cut this off and scoured it by simmering for about an hour in water with a drop of dishwashing liquid and enough washing soda to bring the pH up to about 10. Then I noticed that the fugitive tint was not removed with laundering in 120°F water, but was with the scouring. Also, the scoured piece contracted more than the laundered piece. I wove some more and set my water heater on the hottest, then laundered the new piece in 140°F water, with detergent. This worked to remove the fugitive tint.

Piece laundered at 120°F finished width: 15.625", contraction 15%

Piece laundered at 140°F finished width: 15.125", contraction 16%

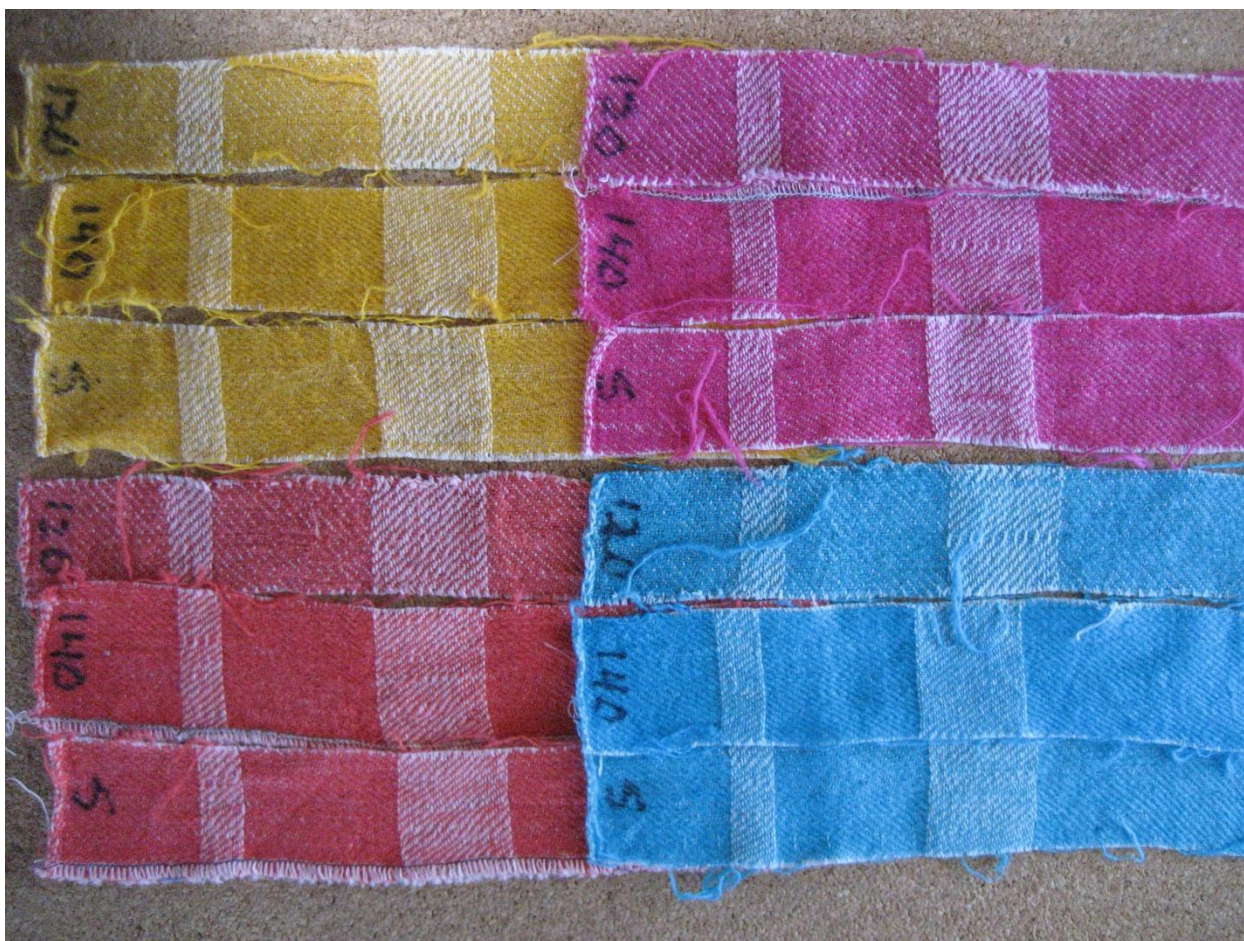
Scoured piece finished width: 15.125", contraction 16%

Looking at them you can't tell the difference between the laundered at 140°F and the scoured; but the scoured was at pH 10, and was kept at temperature longer. I don't know the pH of the water in the washing machine.

So, with these 3 preparation methods, it was time to see whether the dye take-up was different.

I cut 4 strips of each, about an inch wide. I prepared Procion MX Fuchsia, Warm Red, Golden Yellow, and Turquoise in 4 small bowls. I used 1 cup of warm tap water (about 90°F) and about 1/16th teaspoon of dye powder. The three samples only weighed about 4 grams, and this was more dye than really needed for the size of the sample, but I figured I'd get color saturation. I set the timer for 15 minutes, but here the scientific part ends. The phone rang. The bell went off while I was on the phone, and when I hung up I took care of the topic of the call and forgot about the dye experiment. The pieces might have been in the dye liquor about an hour. The temperature when I took them out was around 75°F. The first rinse was nearly clear for all colors, and the second rinse was clear for the turquoise and yellow, but there was still a bare hint of color for the reds. I left it at 2 rinses.

The pieces are marked 120, 140, S for the 3 preparations, and are shown top to bottom. To me, the laundered at 140°F looks better, but looking at the twill in the white stripe it could be my spinning or my beat in weaving. I suppose the agitation of the washing machine could be included in the possible factors. If you pull out some of the weft yarn and compare them, there is no discernable difference. The squares shown on the first page were laundered at 120°F.



Acid Dyes

My friend Nancie McCraw (BadfaerieDesigns.com) uses acid dyes on wool and silk, so I gave her some sliver to play with.

She scoured the sliver by simmering for 45 minutes in 8 liters of water with a touch of Dawn and a tablespoon of washing soda.

She decided to dye the cotton along side the wool and silk, so she used the vinegar that the wool and silk needed. The cotton accepted the Lanaset dyes, but did not do as well with the Jacquard dyes. She neutralized the cotton in soda ash following the dyeing.



Kool-Aid is also an acid dye; I used its less expensive competitor Wyler's with bright results. I used cold water from the tap and the dyes took immediately.

The colors from top to bottom are Tropical Punch, Tropical Punch + Berry Jammer, Berry Jammer, then on the left Berry Jammer + Lemonade, Lemonade. On the bottom left, Cherry Charger and on the right Cherry Charger + lemonade.

Direct Dyes

Direct dyes are notorious for bleeding. The treatment eliminates this problem and renders the direct dyed EZ Dye cotton washfast. Since direct dyes are less expensive than the fiber reactive, this also offers a cost saving to industry.

It should be noted that the reputation direct dyes have stems more from the surprise factor of the color take-up in garments that were white or light colored before washing than the actual bleeding. If the dye bled but did not adhere to other items it probably would not have such a bad reputation. That untreated cotton will accept direct dyes in a pale shade should be taken into account when dyeing mixed treated and untreated fabrics. Light and dark shades can be obtained; I have dyed one such piece but have not completed laundering tests to determine how long the dye lasts in the light colored yarns.



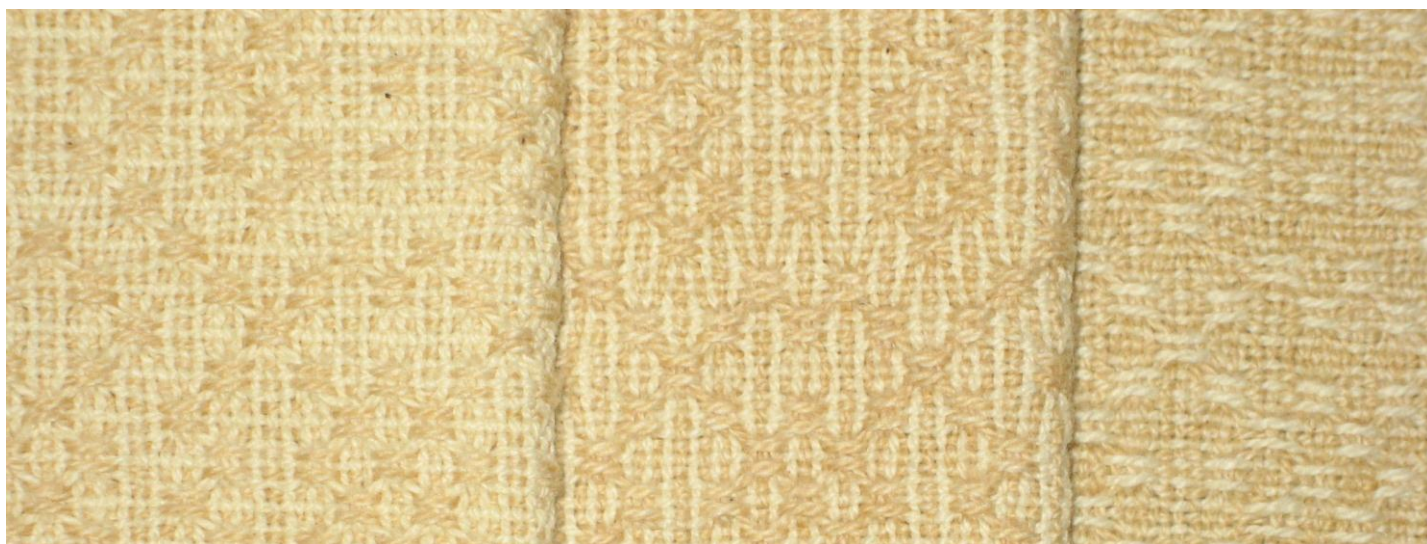
Natural Dyes

There has been very little formal research on natural dyes. What has been done has been done informally by natural dyers using their favorite techniques.

Generally speaking, the EZ Dye cotton can be considered “pre-mordanted”. The exceptions are madder, logwood, and Brazilwood, which have so far produced browns at the usual concentrations.

It should be noted that the treatment is designed to improve washfastness, but does nothing for lightfastness. Dyestuffs that are notorious for fading when exposed to light are not the best candidates for experimentation, but those that dye beautiful colors that wash out in the rinse are good candidates for testing. I have dyed with fresh beet juice and pokeberries which have not washed out of the fabrics.

It should also be noted that some natural dyes will tint untreated cotton. I dyed some pieces in glorious marigolds not realizing that they would tint the untreated cotton. Again, I have not done laundering tests to see how many washes it will take to remove the dye from the untreated cotton.



Mordanting Comparisons

I have done some side by side tests with several natural dyes on treated and untreated cotton. These tests were to get some baseline information so that further experiments could be designed with some focus to them.

I scoured the cotton; I put some aside and mordanted some along with some untreated cotton. So I had Treated, Treated/Mordanted, and Untreated/Mordanted cottons that went into a dyepot together. I used heat up to about 170°F in all of the dyepots, generally for ½ hour.


The tests were done with approximately ¼ ounce (6.7 g) of cotton, comprising ½ yard each of treated (T), treated/mordanted (TM), and untreated/mordanted (UM) cotton sliver. I don't have a scale that will measure the tiny amounts of dye powder, but used very small amounts. The dye baths were all transparent; I could see to the bottom of the pot. I used the tiny amount to show the difference in value of the different treatments. I can't tell with these tests what the percentage should be, and it wasn't the intent. That is left for further experiments, a little more formal than this.


The mordant was alum acetate at 5% solution, dyed weeks earlier. I find that the mordanted cotton is very difficult to wet out after it has dried then cured for weeks. I boiled these in water with chalk added to wet them out.


It was a mistake to put all three samples in the same dyepot; it appears that the EZ Dye cotton is very greedy and took up most of the dye, leaving less for the untreated. Future tests will compare the samples individually. In every case

except the cochineal, there was still color left when I removed the cotton from the dye pot. Two rinses were necessary in only one case.

I put some small samples in the window for 5 days to see if there would be any difference between the mordanted and unmordanted samples.

Dyestuff	Notes	Treated	Treated/ Mordanted	Untreated/ Mordanted
Quebracho Black extract	Approximately 1/16 tsp in 2 cups of water Simmered for a half hour, then left to soak overnight, then rinsed twice.			
Black walnut hulls	4 ratty hulls from the field in 2 cups of water Simmered for a half hour, strained & added cotton, simmered a half hour, left another half hour to cool, then rinsed twice.			
Quebracho Green extract	Approximately 1/8 tsp in 2 cups of water Simmered for a half hour, then left to soak several hours, then rinsed.			
Cochineal extract	Total about 1/16 th tsp in 2 cups of water Started with much less than 1/16 tsp, simmered for ½ hour; the dye liquor was almost clear, so I added a tiny bit more (first mixed with water) and let it simmer a little longer. Repeated the addition—it appears the treated cotton is soaking it all up. Took it off the heat and let it sit about 4 hours; the dye liquor was almost clear. Single rinse was clear.			

Dyestuff	Notes	Treated	Treated/ Mordanted	Untreated/ Mordanted
Quebracho Black extract	<p>Approximately 1/16 tsp in 2 cups of water</p> <p>Simmered for a half hour, then left to soak overnight, then rinsed twice.</p> <p>Exposed to sunlight 5 days</p>			
Black walnut hulls	<p>4 ratty hulls from the field in 2 cups of water</p> <p>Simmered for a half hour, strained & added cotton, simmered a half hour, left another half hour to cool, then rinsed twice.</p> <p>Exposed to sunlight 5 days</p>			
Quebracho Green extract	<p>Approximately 1/8 tsp in 2 cups of water</p> <p>Simmered for a half hour, then left to soak several hours, then rinsed.</p> <p>Exposed to sunlight 5 days</p>			
Cochineal extract	<p>Total about 1/16th tsp in 2 cups of water</p> <p>Started with much less than 1/16 tsp, simmered for ½ hour; the dye liquor was almost clear, so I added a tiny bit more (first mixed with water) and let it simmer a little longer. Repeated the addition—it appears the treated cotton is soaking it all up.</p> <p>Took it off the heat and let it sit about 4 hours; the dye liquor was almost clear. Single rinse was clear.</p> <p>Exposed to sunlight 5 days</p>			

Dyestuff	Notes	Treated	Treated/ Mordanted	Untreated/ Mordanted
<p>Madder (rubia tinctoria)</p> <p>Previous mordanted samples were wetted out in boiling water. From here on, chalk was added to the water.</p>	<p>Quantity unknown; I poured hot water into an empty madder jar with residual madder on the sides.</p> <p>Simmered at about 170°F for an hour. Removed from heat and let sit about an hour. Single rinse was clear.</p>			
<p>Osage orange extract</p>	<p>About 1/8th tsp in 2 cups water.</p> <p>Simmered at about 170°F for 1/2 hour. Removed from heat and let sit about an hour. Single rinse was clear.</p>			
<p>Beet juice, cooked</p>	<p>I juiced a beet and used a teaspoon of juice in 2 cups of water.</p> <p>I simmered for about a half hour, then let it sit a few hours. It browned considerably as it sat.</p>			
<p>Beet juice, fresh</p>	<p>I took some of the pulp from the juiced beet and put it in a jar with a tablespoon of water. I let that sit for a few minutes, then wetted out some samples and put them in a pan. I strained the beet pulp through a strainer with a coffee filter in it, letting the juice cover the wet fiber. I then used the coffee filter holding the pulp to press the juice around. I let it sit a few hours, without heat, then rinsed. The untreated/mordanted cotton did not hold any of the color.</p>			

Dyestuff	Notes	Treated	Treated/ Mordanted	Untreated/ Mordanted
<p>Madder (rubia tinctoria)</p> <p>Previous mordanted samples were wetted out in boiling water. From here on, chalk was added to the water.</p>	<p>Quantity unknown; I poured hot water into an empty madder jar with residual madder on the sides.</p> <p>Simmered at about 170°F for an hour. Removed from heat and let sit about an hour. Single rinse was clear.</p> <p>Exposed to sunlight 5 days</p>			
<p>Osage orange extract</p>	<p>About 1/8th tsp in 2 cups water.</p> <p>Simmered at about 170°F for 1/2 hour. Removed from heat and let sit about an hour. Single rinse was clear.</p> <p>Exposed to sunlight 5 days</p>			
<p>Beet juice, cooked</p>	<p>I juiced a beet and used a teaspoon of juice in 2 cups of water.</p> <p>I simmered for about a half hour, then let it sit a few hours. It browned considerably as it sat.</p> <p>Exposed to sunlight 5 days</p>			
<p>Beet juice, fresh</p>	<p>I took some of the pulp from the juiced beet and put it in a jar with a tablespoon of water. I let that sit for a few minutes, then wetted out some samples and put them in a pan. I strained the beet pulp through a strainer with a coffee filter in it, letting the juice cover the wet fiber. I then used the coffee filter holding the pulp to press the juice around. I let it sit a few hours, without heat, then rinsed. The untreated/mordanted cotton did not hold any of the color.</p> <p>Exposed to sunlight 5 days</p>			

Dyestuff Proportions

The next step was to see what the proportions are really needed. We know that less dye is required, but how much less is not given. So I used a scale that measures in increments of 0.1 gram. I would not exactly call the tests accurate, but I wanted to get in the ballpark. I used strips of sliver that weighed between 2.5 and 3 grams, and measured out madder (*rubia tinctoria*) at 6% of the 3 grams, or 0.2 grams. I mixed that with 2.25 cups of hot water, measured $\frac{3}{4}$ cup out twice to put in 2 jars. I diluted the remaining $\frac{3}{4}$ cup with 1.5 cups, or 2%, and did that again twice. So I had 4 jars each for the treated and untreated/mordanted for comparison. The percentages were 6, 2, .7, .2. Each fiber had its own jar, so I could make the comparison

The water I used was hot tap water, and I let them sit for a few minutes to see if the EZ Dye took the dye readily at that temperature. I wasn't very patient, so after about 10 minutes I put all 8 jars in a canning pot and brought the water bath up to a boil so that the water in the jars was at 180°F. I let it sit at that temp about 15 minutes, then rinsed.

When wet, the color difference between the treated and untreated is dramatic; the treated is much more purple than red except at the 6% level, where the treated is more brown.

Next I did Quebracho Black, but in the proportions I meant to do in the first test. I used 10% wof as the starting point. I measured out 750 ml hot water and mixed in the dye powder. Then measured 200 ml into each of the first 2 jars, 100 ml into another 2 jars, 50, then 25. I filled the last 6 up to 200 ml for 10, 5, 2.5, and 1.25%.

I heated these in a boiling water bath for an hour, with the lid on. The temp in the jars got up to 200°F.

It also appears, while the fiber is still wet, that the EZ Dye picks up a purple cast.

Based on these two results, I think I'd target more than half, maybe $\frac{2}{3}$ to $\frac{3}{4}$ of the usual natural dyestuff for treated cotton. Note that in neither case did I stir the fiber while it was in the dye liquor. You can see hot spots especially in the untreated/mordanted samples.

I think it's also interesting that you can see distinct gradations in the treated Q. Black and in the untreated/mordanted madder.

% wof	Madder Treated	Untreated/Mordanted
6		
2		
0.66		
0.22		
% wof		
10	Quebracho Black Treated	Untreated/Mordanted
5		
2.5		
1.25		

The color remaining in the jars after dyeing with madder is also interesting.

