PAINTING THE PACIFIC:

A Comparative Analysis of the Lightfastness of Watercolors Made from Indigenous Plants in the Pacific Region

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EARLY PACIFIC ISLANDERS

- The people of the Pacific relied on their environment to survive.
- Pacific Islanders used indigenous plants, animals, and other natural resources to create and establish their culture.

COLORANTS OF THE PACIFIC

Ochrosia mariannensis

Morinda citrifolia

Thespesia populnea

Pandanus tectorius

COLORANTS TODAY

- Natural colorants were soon replaced by more inexpensive and accessible, synthetic colorants.
- Synthetic colorants oftentimes contain toxic pigments, harmful solvents, and other hazardous materials that can be detrimental to the environment and human health.

OBJECTIVE

- To determine the lightfastness of watercolor paints made from langiti (*Ochrosia mariannensis*), ladda (*Morinda citrifolia*), binalo (*Thespesia populnea*), and kaffo' (*Pandanus tectorius*) when exposed to longer wavelengths of UVA light and shorter wavelengths of UVB light.

- To compare the lightfastness of natural watercolors to synthetic watercolors under exposure to UVA and UVB light.

Ochrosia mariannensis

Morinda citrifolia

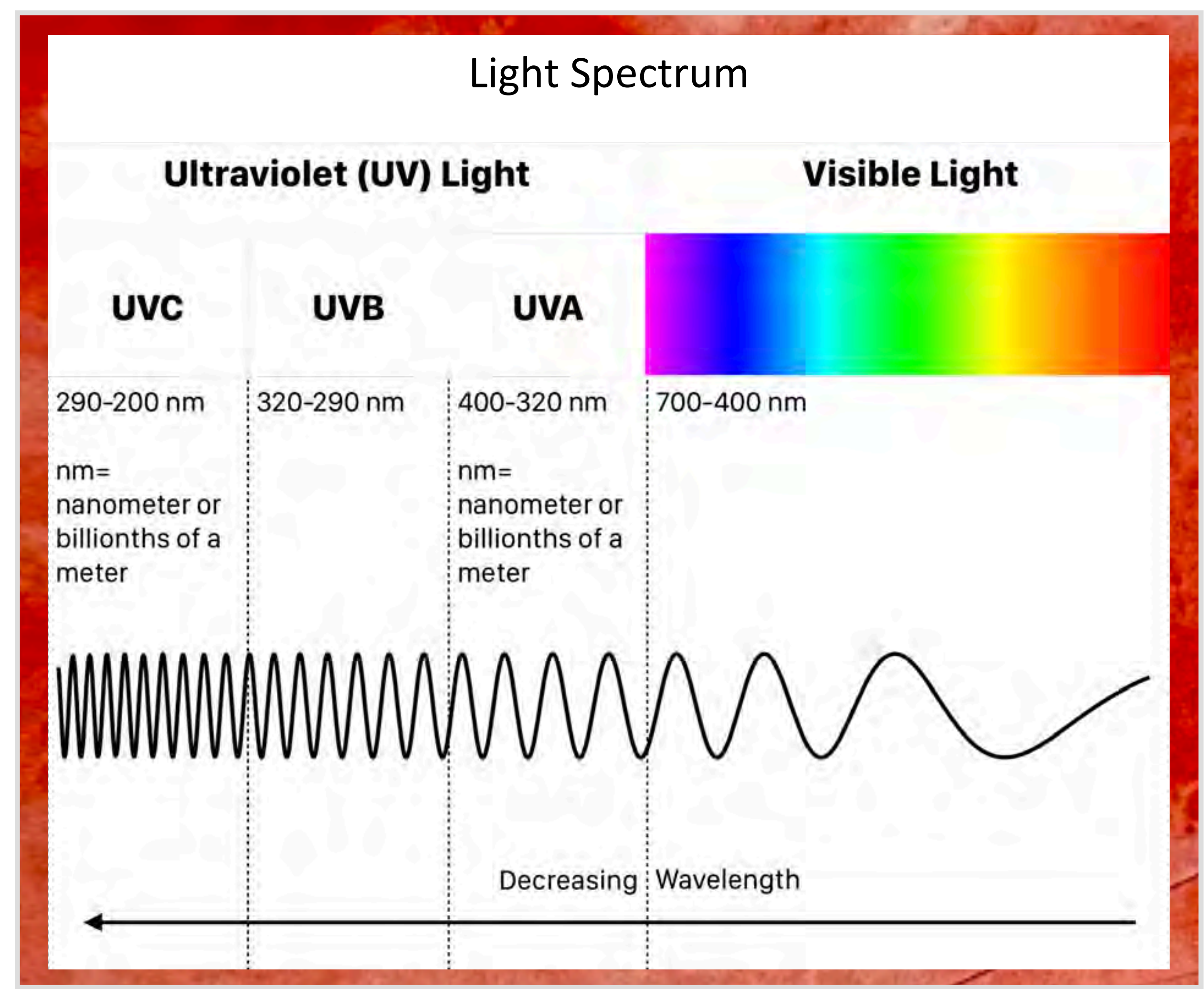
Thespesia populnea

Pandanus tectorius

LIGHTFASTNESS

- How resistant a colorant is to fading when exposed to light.
- Colorants are especially vulnerable to UV exposure.
- Various scales are used to measure lightfastness.

  American Society for Testing and Materials (ASTM) D 4303

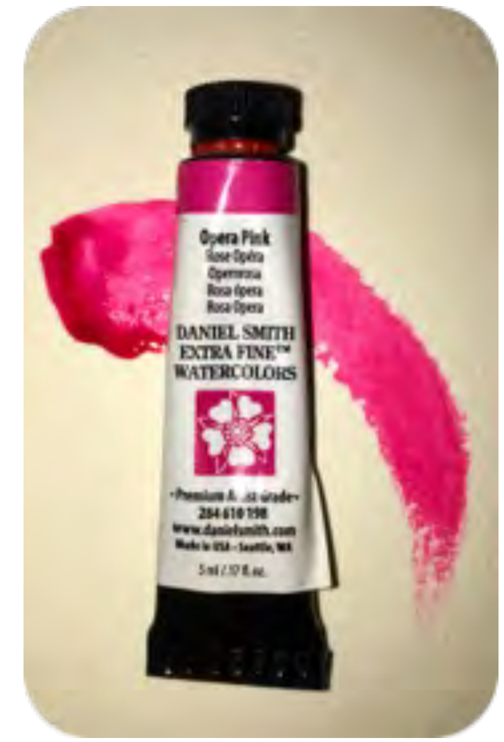


ASTM D 4303 WATERCOLORS

Winsor and Newton Cadmium Red (Lightfastness I)

Grumbacher Academy Gamboge Hue (Lightfastness II)

Daniel Smith Alizarin Crimson (Lightfastness III)



Daniel Smith Opera Pink (Lightfastness IV)

HYPOTHESIS

Natural watercolor paints made from *Ochrosia mariannensis, Morinda citrifolia, Thespesia populnea,* and *Pandanus tectorius* will have a lower lightfastness rating than synthetic watercolors when exposed to UVA and UVB light.

METHODS

A. Extracting the pigment:

1. Pigments were extracted from the biomass with ethyl alcohol.
2. Ethyl alcohol was removed from the concentrated dye through rotary evaporation.
3. Dried pigment was then rehydrated.

B. Making the lake pigment:

1. Potassium aluminum sulfate solution and potassium carbonate solutions were prepared.
2. Solutions were added to the aqueous dye.
3. Lake pigment was precipitated.
4. Lake pigment was processed.

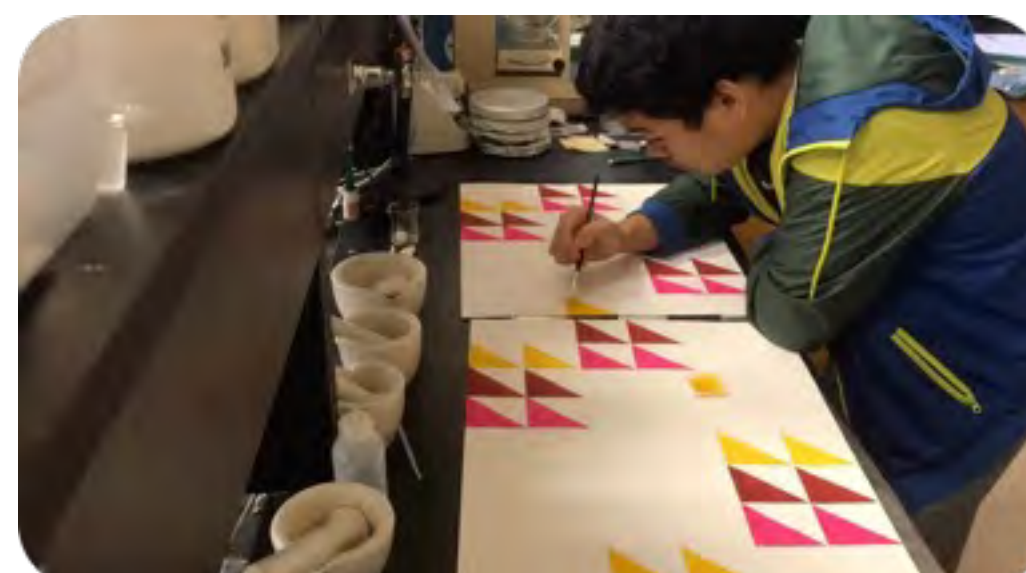
METHODS

C. Making the watercolor paints:

1. Lake pigment was ground into a fine powder with a mortar and pestle.
2. Lake pigment was mixed and mulled with gum arabic and honey.

D. Swatching the watercolor paints:

1. Watercolors were swatched in different concentrations — masstone (1:1) and tint (1:10).
2. Test papers were then allowed to dry.



METHODS

E. Conducting the UV exposure test:

1. Swatched test papers were separately subjected to an accelerated UVA and UVB exposure test for 12 days.


UVA Exposure

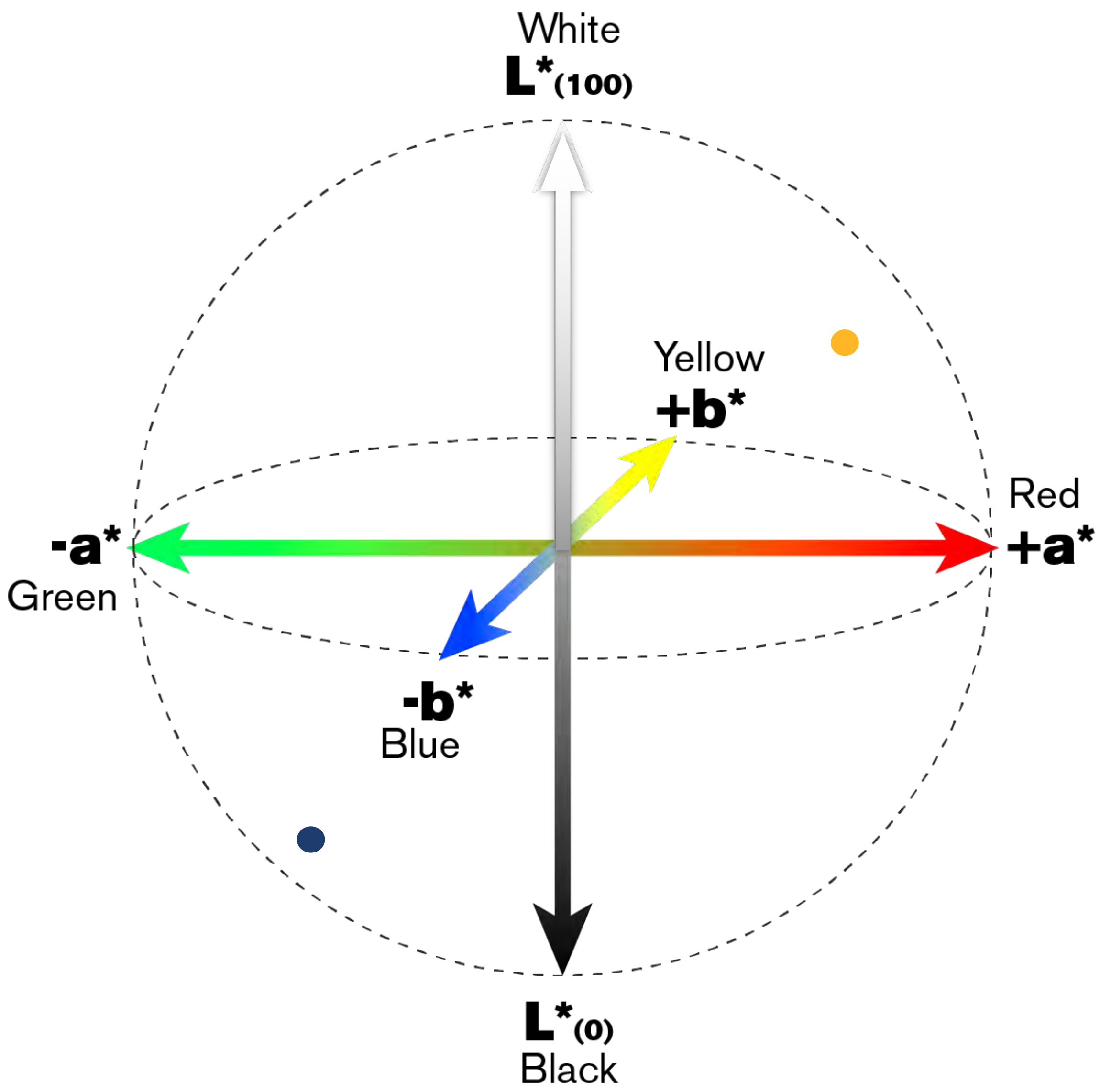

UVA Exposure


UVB Exposure

METHODS

E. Conducting the UV exposure test:

2. L*a*b* coordinates of each watercolor paint was measured every 48 hours with a spectrocolorimeter.



WATERCOLOR TEST PAPER LAYOUT

Legend:

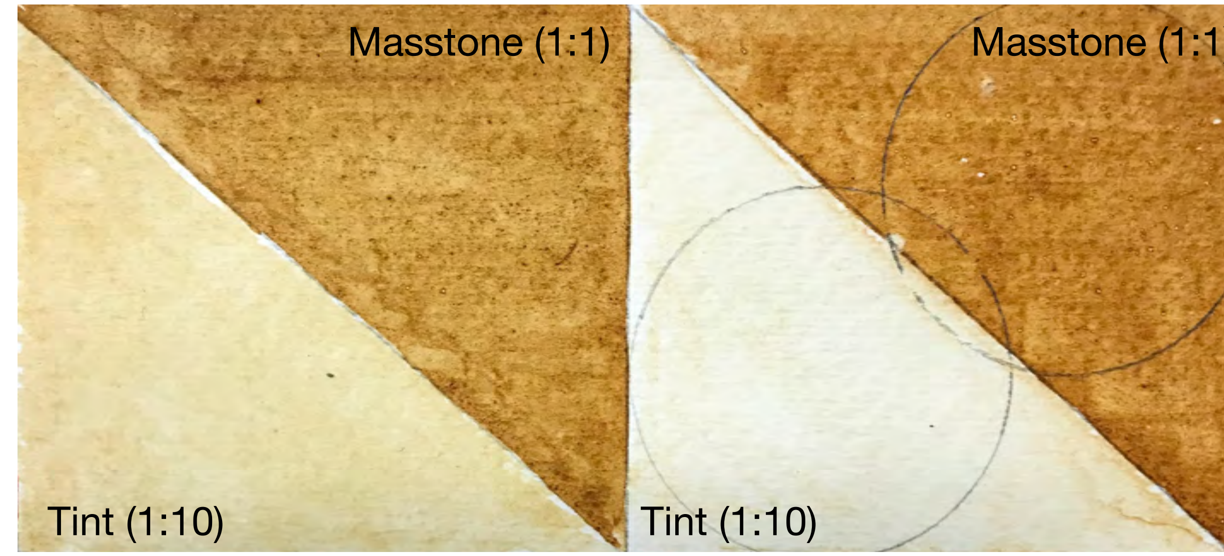
- *Ochrosia mariannensis* (O)
- *Morinda citrifolia* (M)
- *Thespesia populnea* (T)
- *Pandanus tectorius* (P)
- DS Opera Pink (F)
- DS Alizarin Crimson (A)
- GA Gamboge Hue (G)
- WN Cadmium Red (C)
- Unexposed to UV light (*)

RESULTS

Ochrosia mariannensis

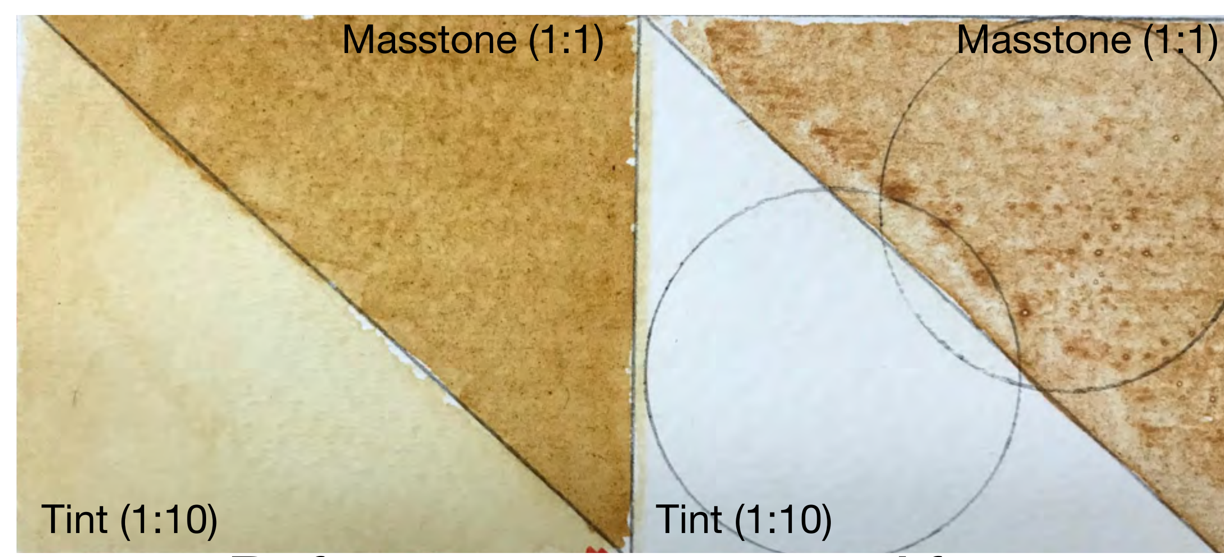
- Generally became lighter, redder, and bluer
- Masstone experienced greater discoloration in UVB exposure test.
- Tint completely faded to the lightness of the paper in the UVB exposure test.

UVA Exposure



Before After

UVB Exposure

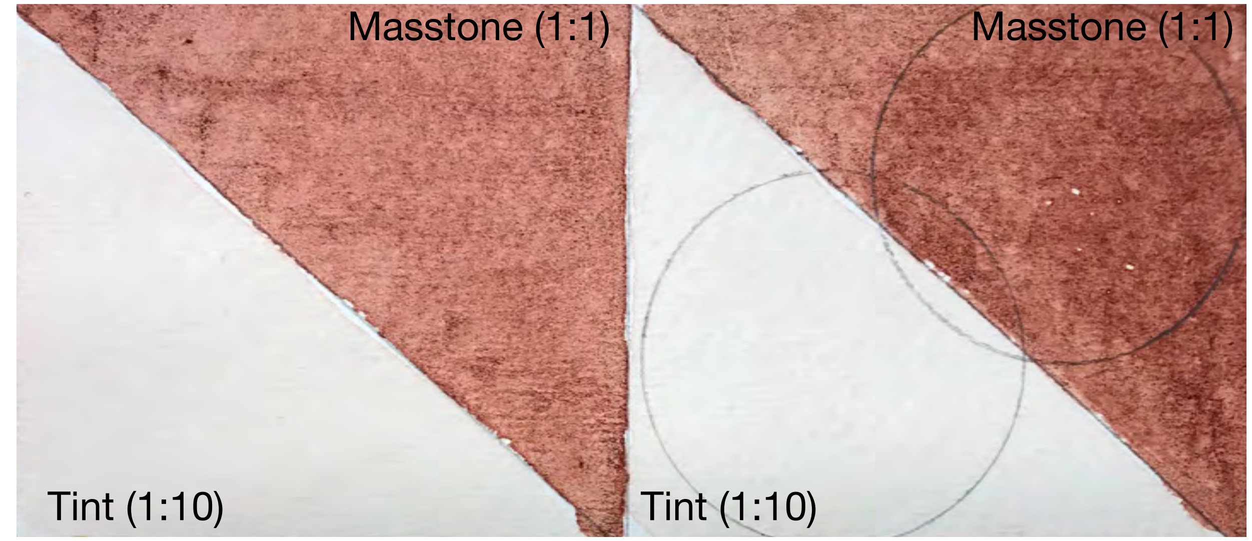


Before After

Morinda citrifolia

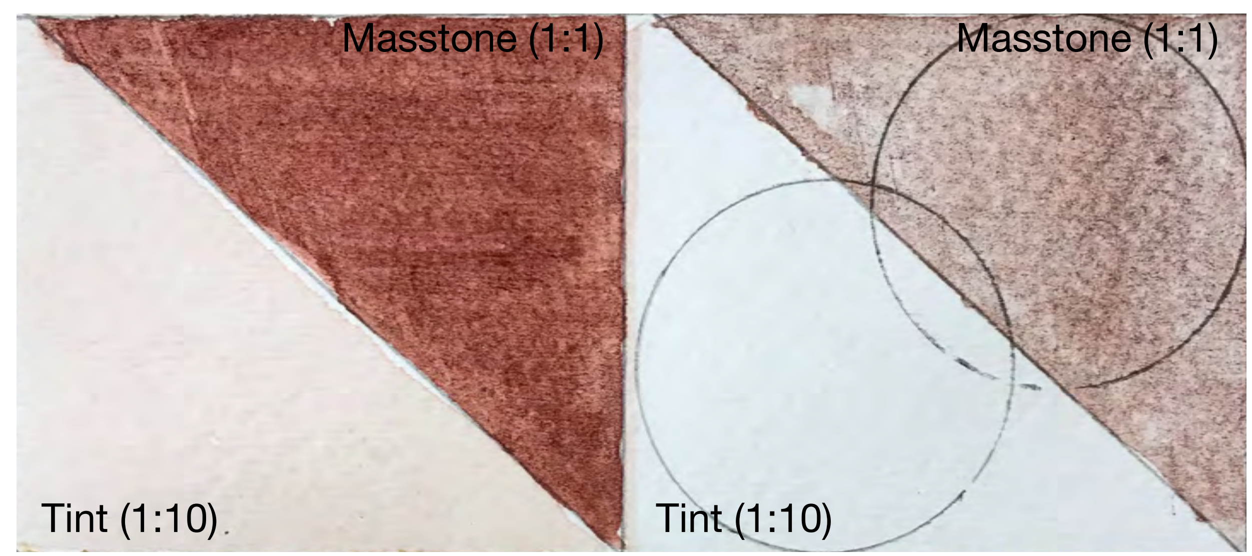
- Generally became lighter, greener, and bluer.
- Masstone experienced greater discoloration in UVB exposure test.
- Tint completely faded to the lightness of the paper in the UVB exposure test.

UVA Exposure



Before After

UVB Exposure

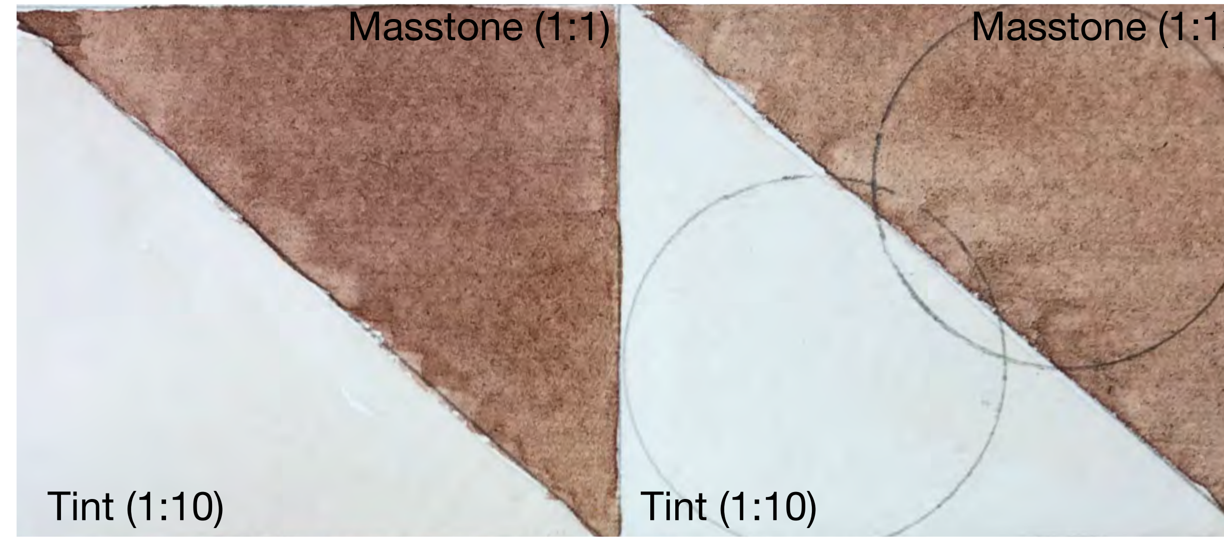


Before After

Thespesia populnea

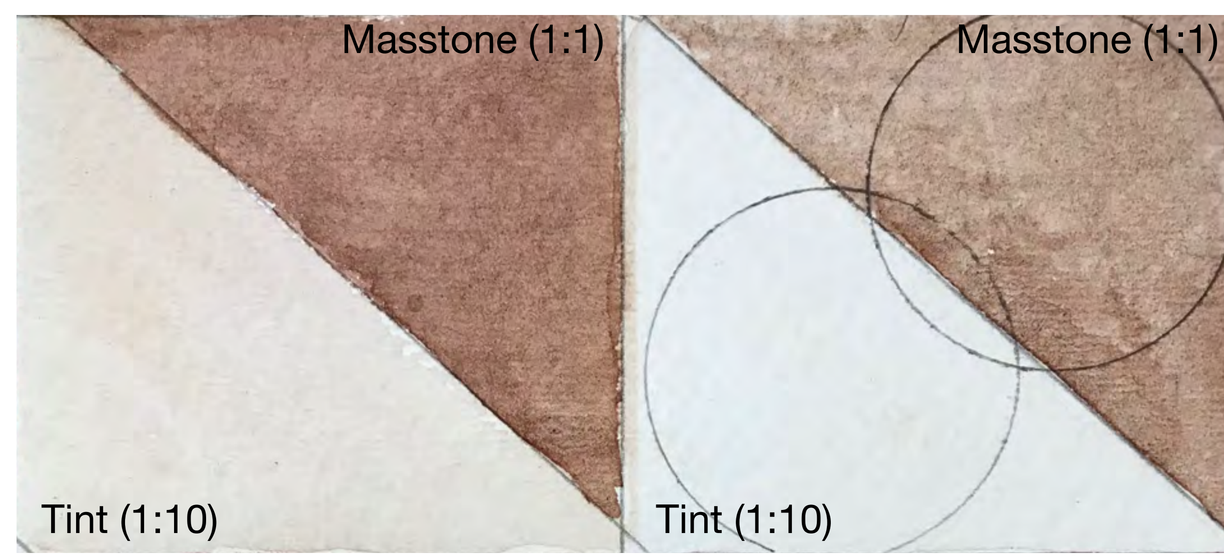
- Generally became lighter, greener, and bluer.
- Experienced little color change in both exposure tests.

UVA Exposure



Before After

UVB Exposure

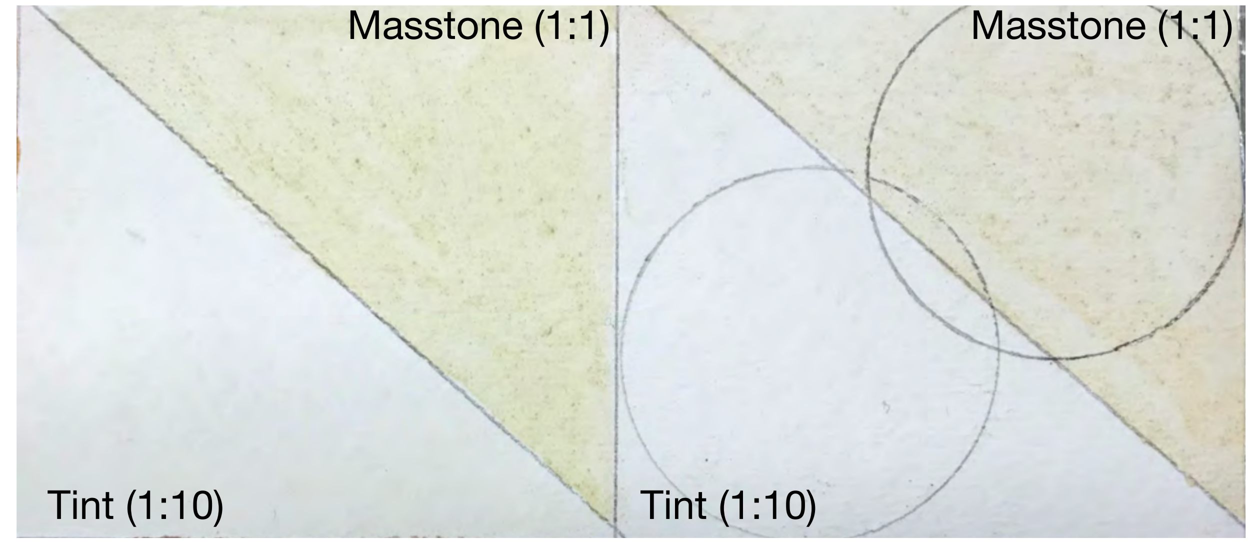


Before After

Pandanus tectorius

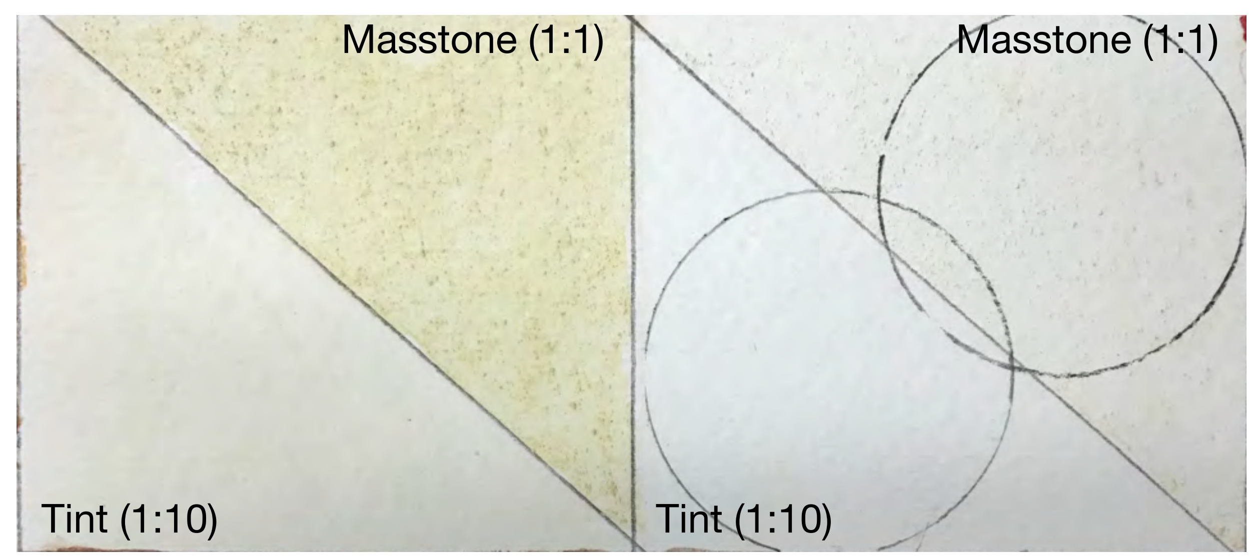
- Became lighter, redder, and bluer.
- Masstone experienced greater discoloration in UVB exposure test.
- Tint completely faded to the lightness of the paper in the UVA and UVB exposure tests.

UVA Exposure



Before After

UVB Exposure

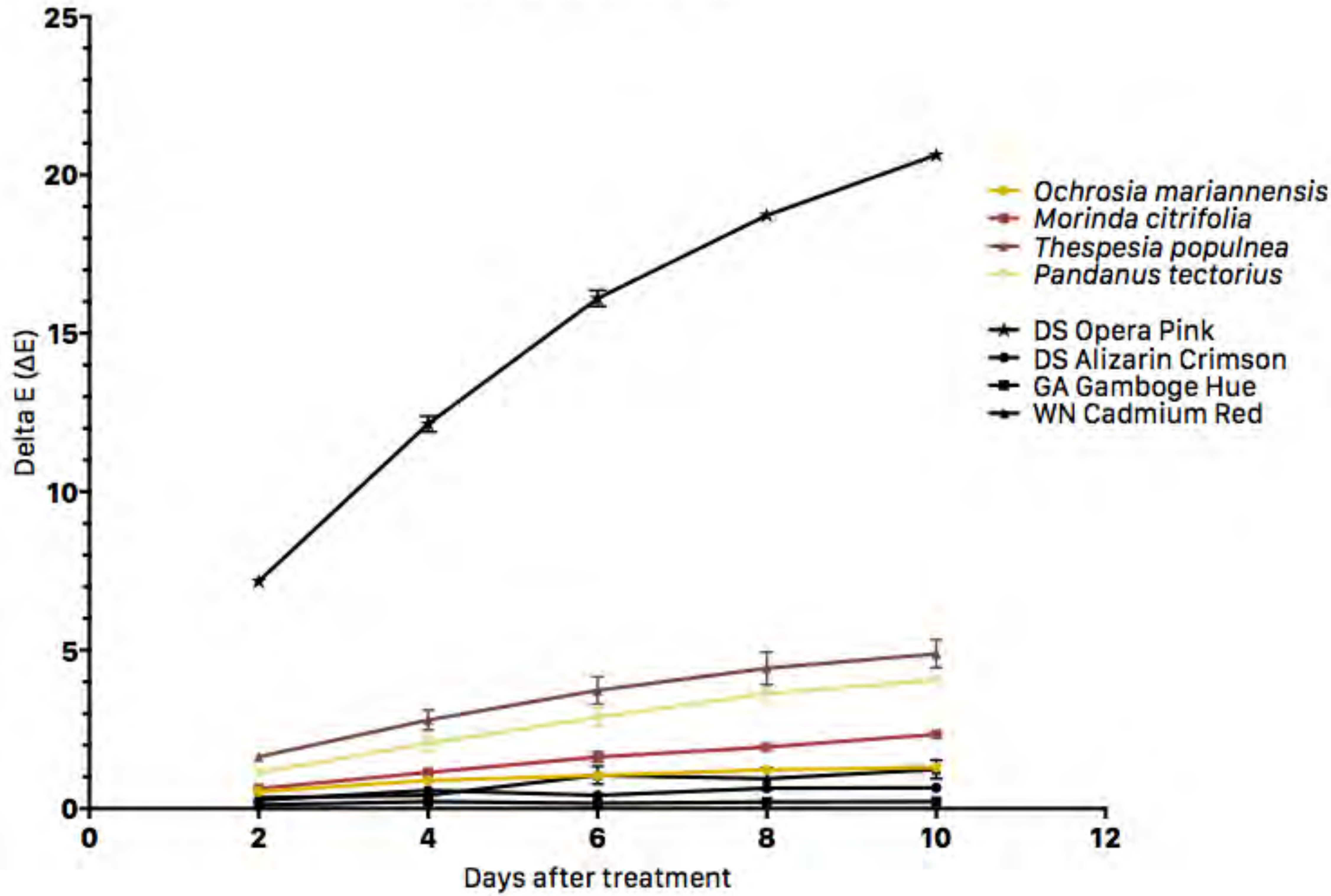


Before After

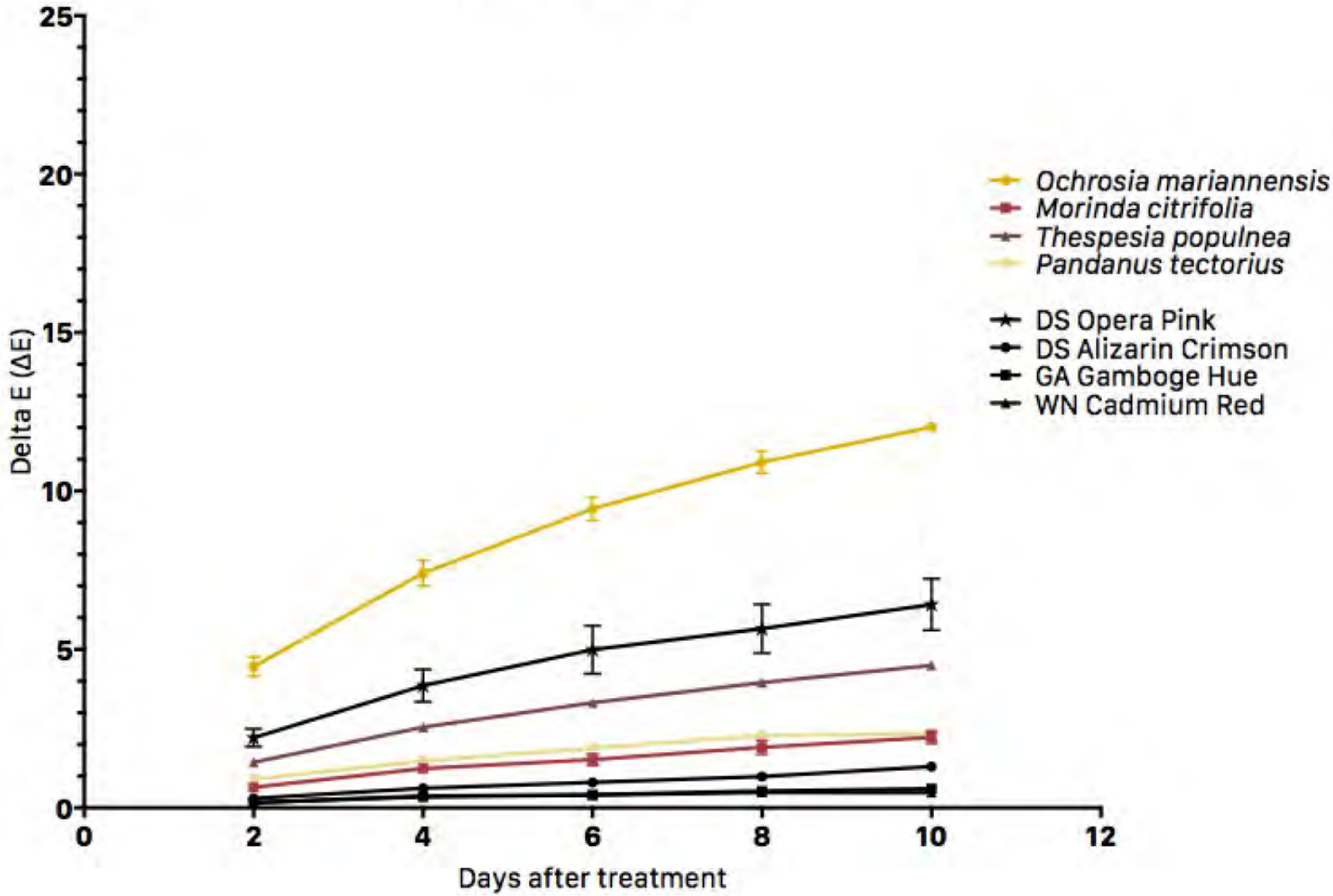
CIE DELTA E 76 COLOR DIFFERENCE FORMULA

$$\Delta E_{ab}^{*} = \sqrt{(L_2^* - L_1^*)^2 + (a_2^* - a_1^*)^2 + (b_2^* - b_1^*)^2}$$

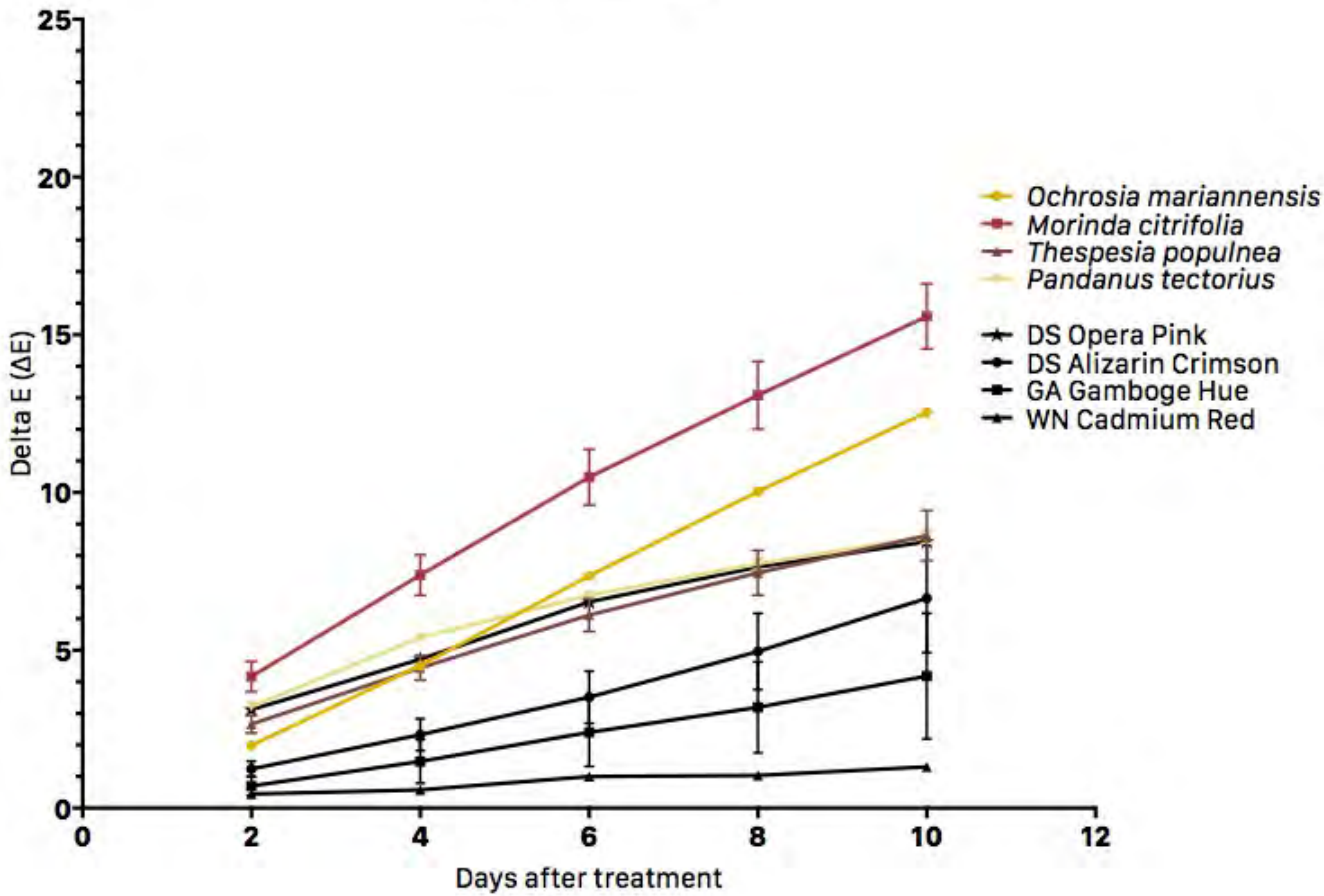
UVA EXPOSED MASSTONES (1:1)



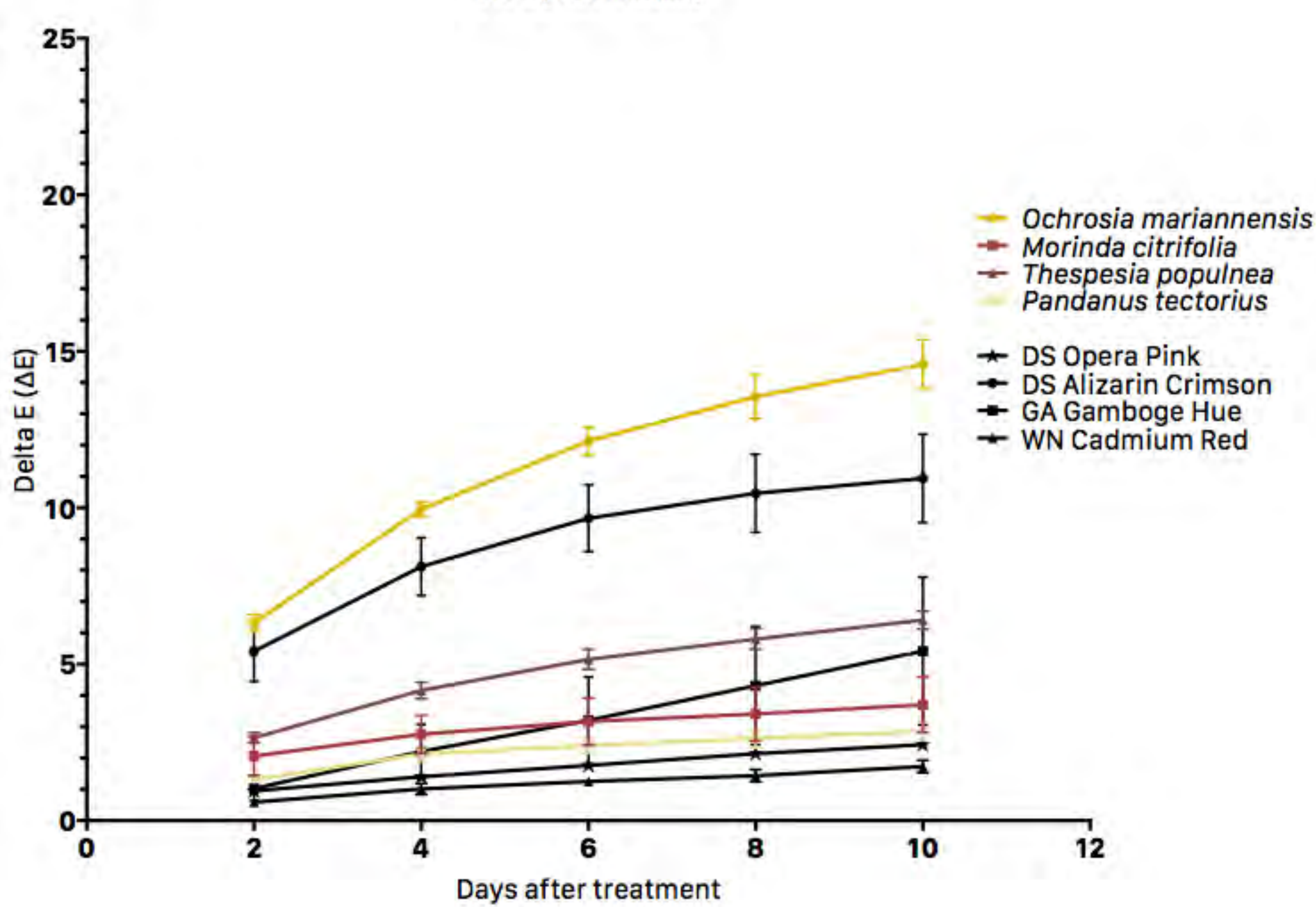
UVA EXPOSED TINTS (1:10)



UVB EXPOSED MASSTONES (1:1)



UVB EXPOSED TINTS (1:10)



CONCLUSION

- After both UV exposure tests, all natural watercolors displayed more color change than the majority of synthetic name-brand watercolors rated with a lightfastness of III or less.

- Masstones and tints of *Ochrosia mariannensis* showed more color change than all synthetic name-brand watercolors in the UVA and UVB exposure test. The tints also completely faded to the lightness of the paper. However, the watercolor experienced less color change than DS Opera Pink (Lightfastness IV) as a masstone in the UVA exposure test.

- Masstone and tint of *Morinda citrifolia* showed less color change than DS Opera Pink (Lightfastness IV) in the UVA exposure test. However in the UVB exposure test, the masstone experienced more color change than all synthetic name-brand watercolors while the tint completely faded to the lightness of the paper.

CONCLUSION

- In the UVA exposure test, the masstone of *Pandanus tectorius* displayed less color change than DS Opera Pink (Lightfastness IV). In the UVB exposure test, the masstone of *Pandanus tectorius* displayed similar color change to DS Opera Pink (Lightfastness IV). Tints completely faded to the lightness of the paper in both exposure tests.

- Watercolor made from *Thespesia populnea* appeared to be the most lightfast natural watercolor, even outperforming DS Opera Pink (Lightfastness IV) and performing similar or slightly worse than DS Alizarin Crimson (Lightfastness III) in both exposure tests.

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