Application of extracted fungal pigments as natural colorants on monocotyledons

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Introduction

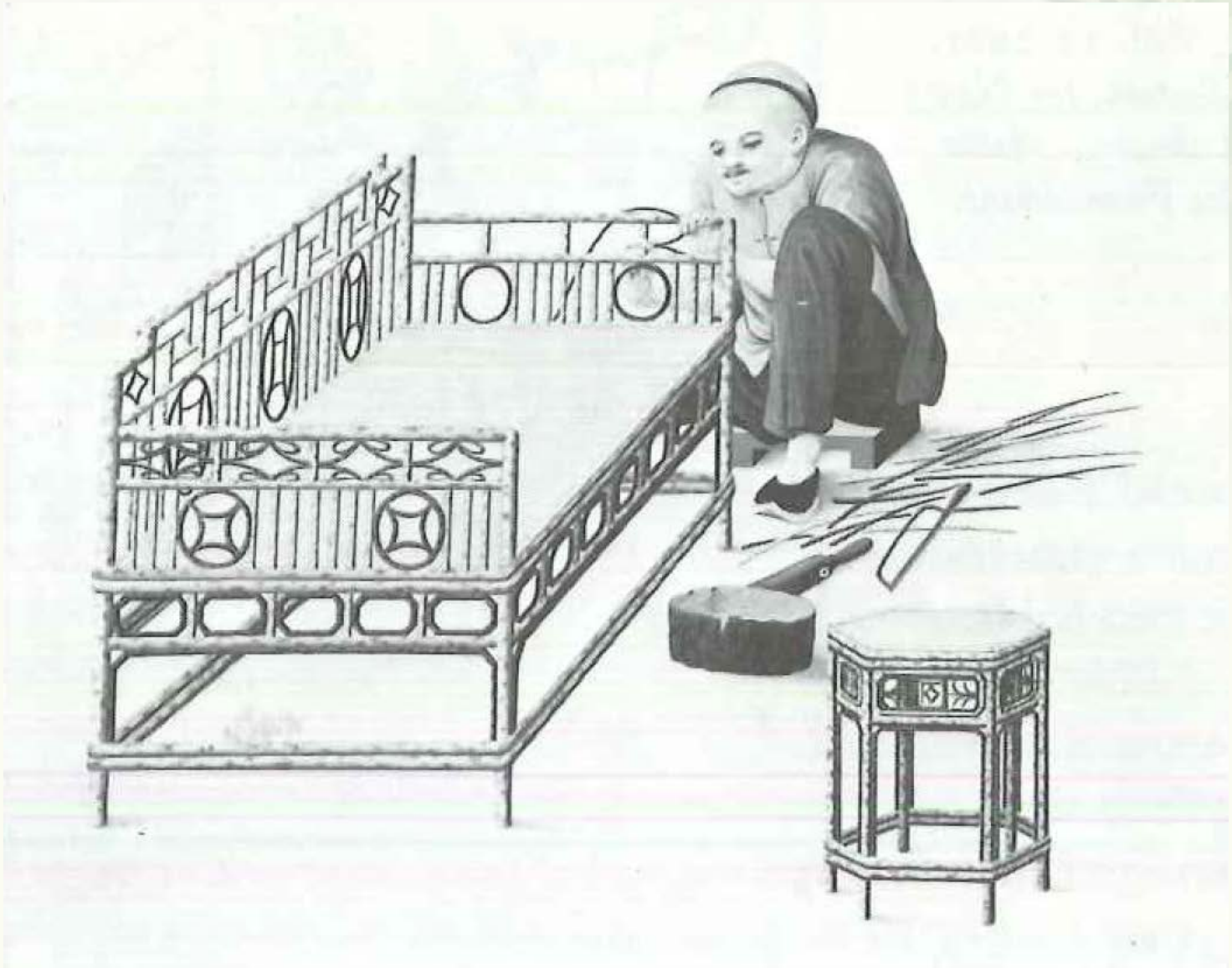
- Monocotyledons

http://m1.i.pbase.com

http://www.kimmei.com

- Traditional use of bamboo

China, 15th Century



Antique bamboo furniture, 1979

https://anotherheader.files.wordpress.com

Actual use of bamboo and black palm

http://i.huffpost.com

https://homeiq.files.wordpress.com

http://www.bambooindustry.com

http://www.ebay.ie

http://photos1.blogger.com

http://cdn.furniturefashion.com

http://blog.wellappointedhouse.com

- Commercial staining pigments

Content of heavy metals

Lead, Cadmium, Cobalt, etc.

Derivate of petroleum

Some of them are toxic

http://cdn1.bigcommerce.com

http://1.imimg.com

http://image.ec21.com/

- Fungal pigments

  Secondary metabolites

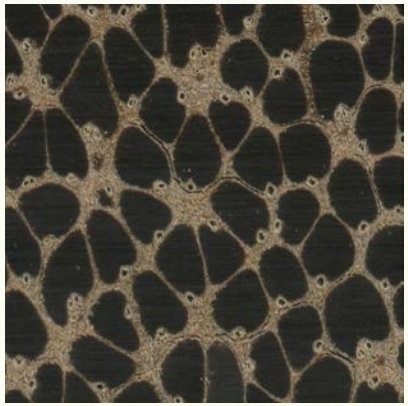
  Traditionally used for spalting wood

http://www.corvallisadvocate.com

Materials

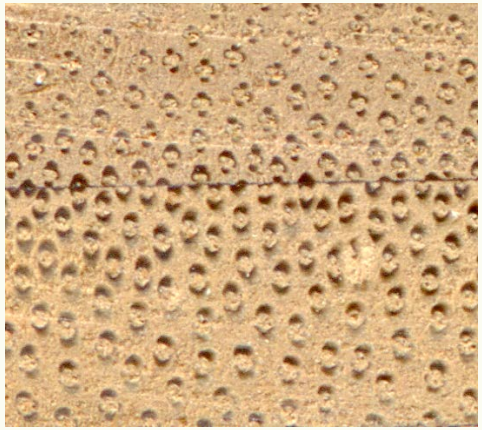
- Blocks of 14mm of section of:

  Black palm (*Borassus flabellifer*)



http://www.wood-database.com

  Bamboo (*Bambusa gigantea*)



- Extracted pigments of:

Scytalidium cuboideum

Scytalidium ganodermophthorum

Chlorociboria aeruginascens

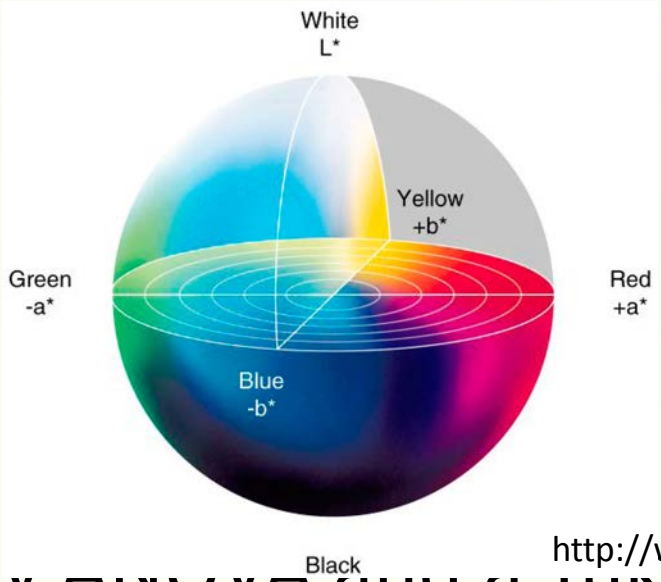
Methods

- Eight treatments where applied (*Robinson et al*, 2014):

Treatment	Description
1	One drip applied
5	Five drips applied
10	Ten drips applied
40	Forty drips applied
28 -24h-28	28 drips applied, then a pause of 24 hours, and then 28 more drips
50-24h-50	50 drips applied, then a pause of 24 hours, and then 50 more drips
60	Sixty drips applied

- The pigment was applied with a glass pipette, drop by drop, letting the DCM evaporate on each application

- After the treatment the blocks were color read using a Konica Minolta CR-5 chroma meter for determining the CIE L*a*b color space.

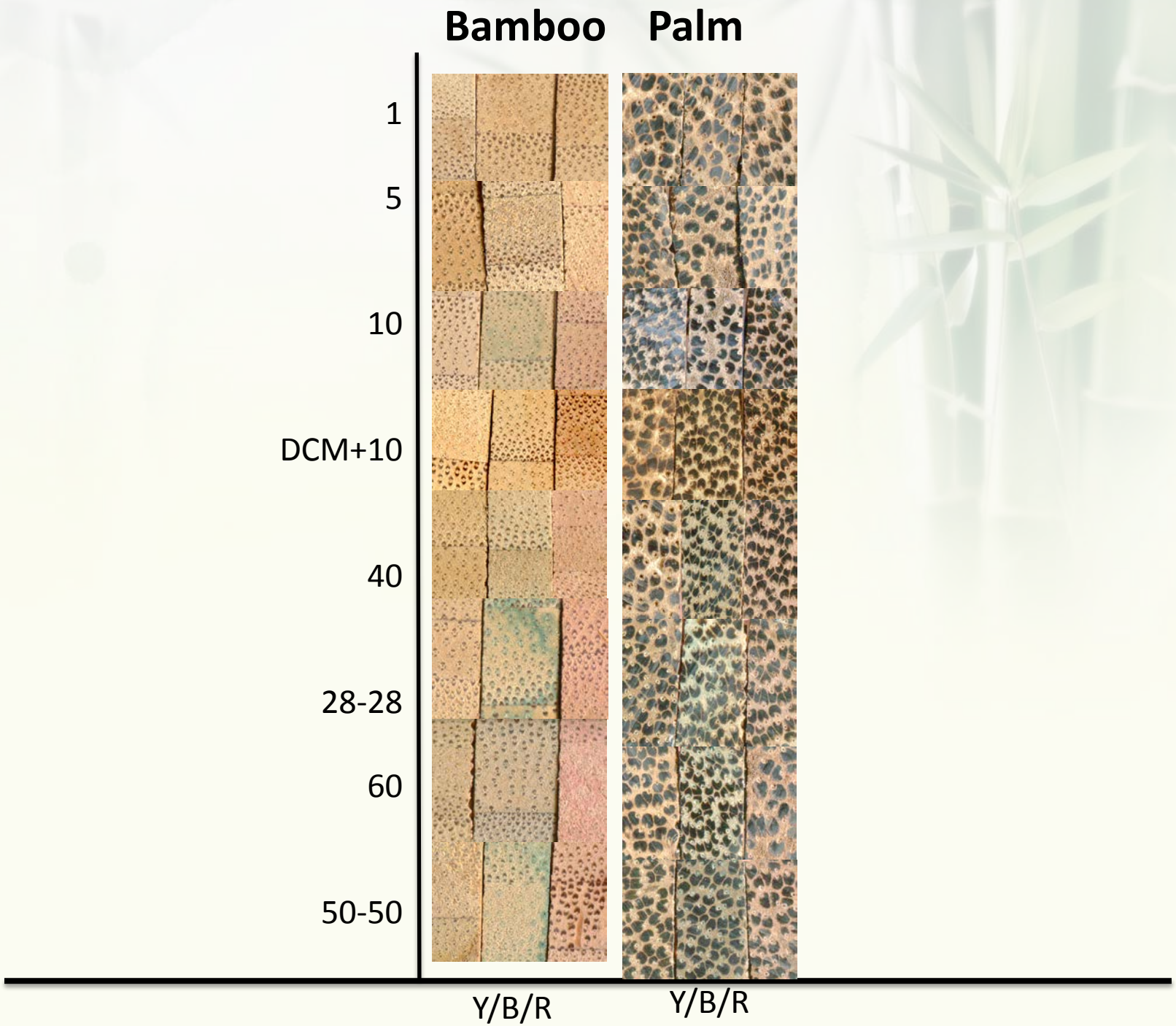


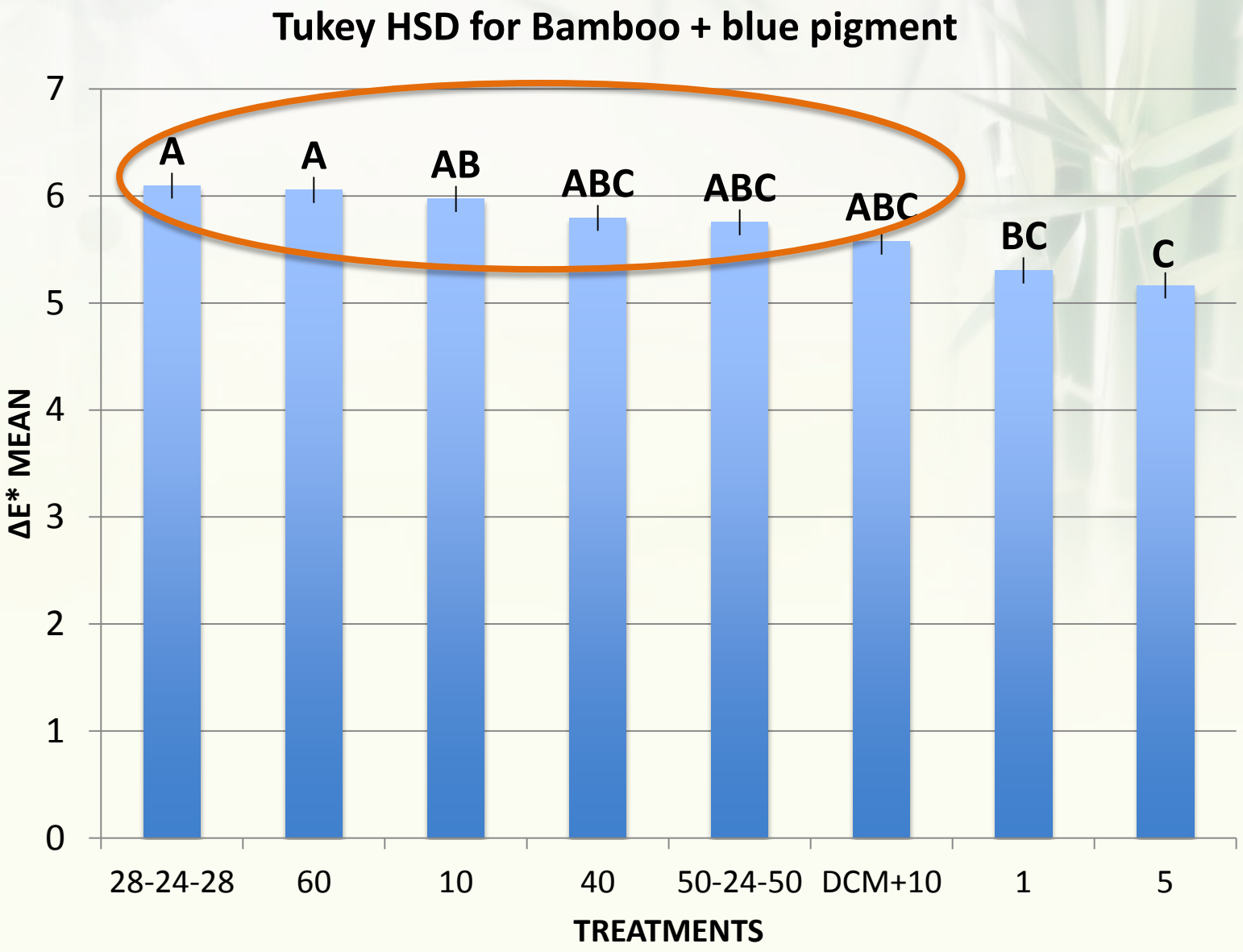
http://www.mdpi.com

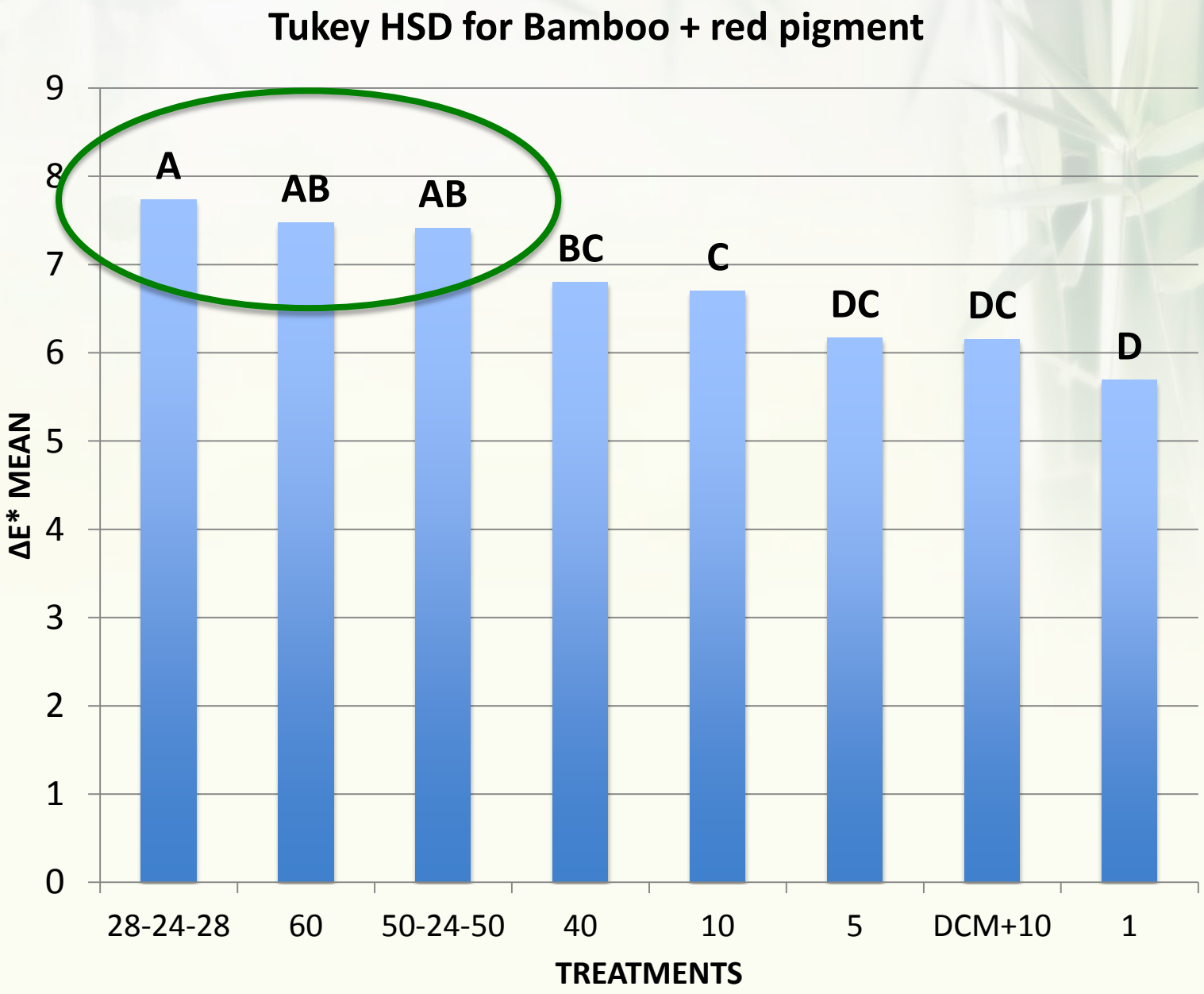
- A one-way ANOVA and a Tukey HSD test was performed using SAS 9.4 on the mean ΔE* obtained on the color reader.

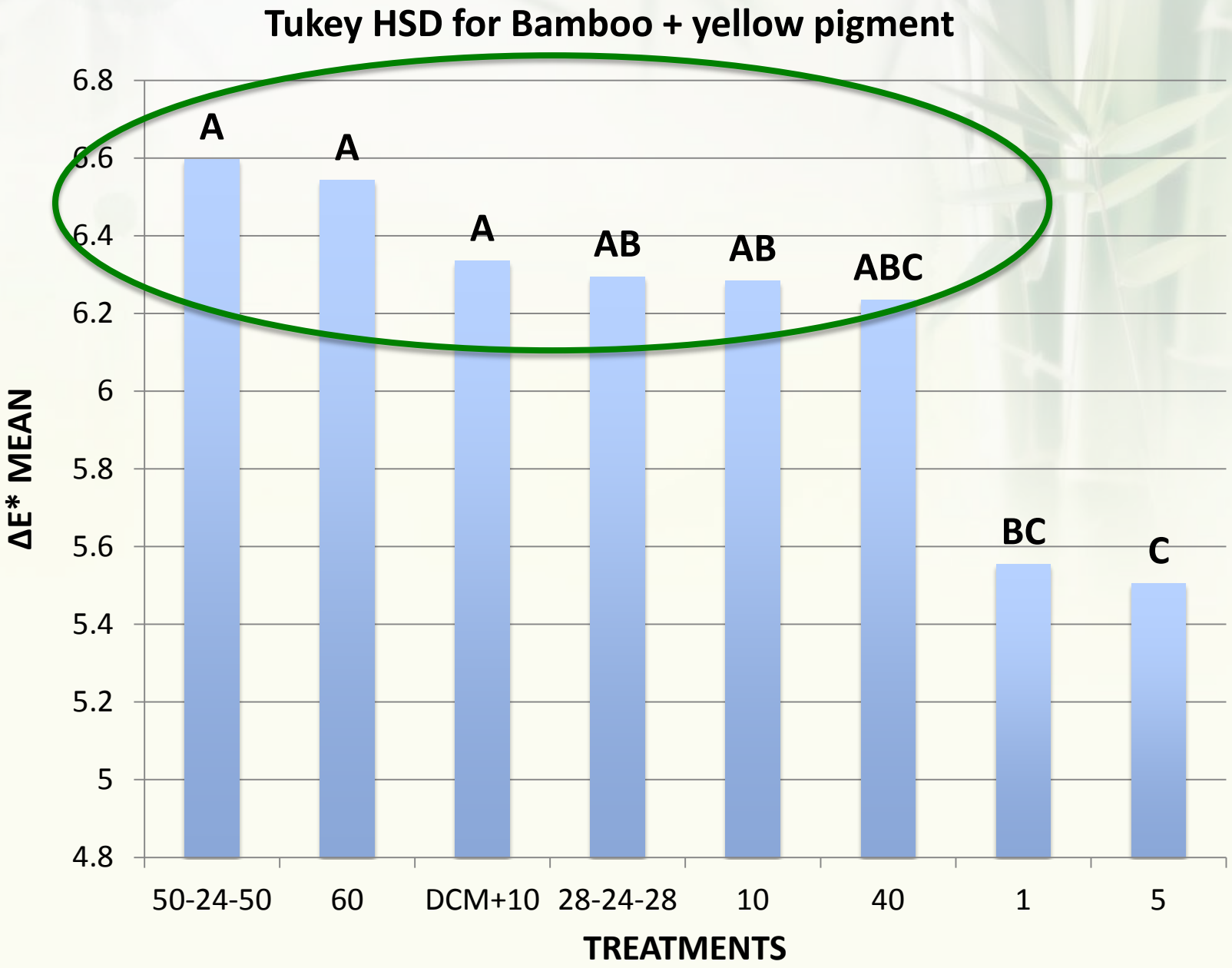
Results

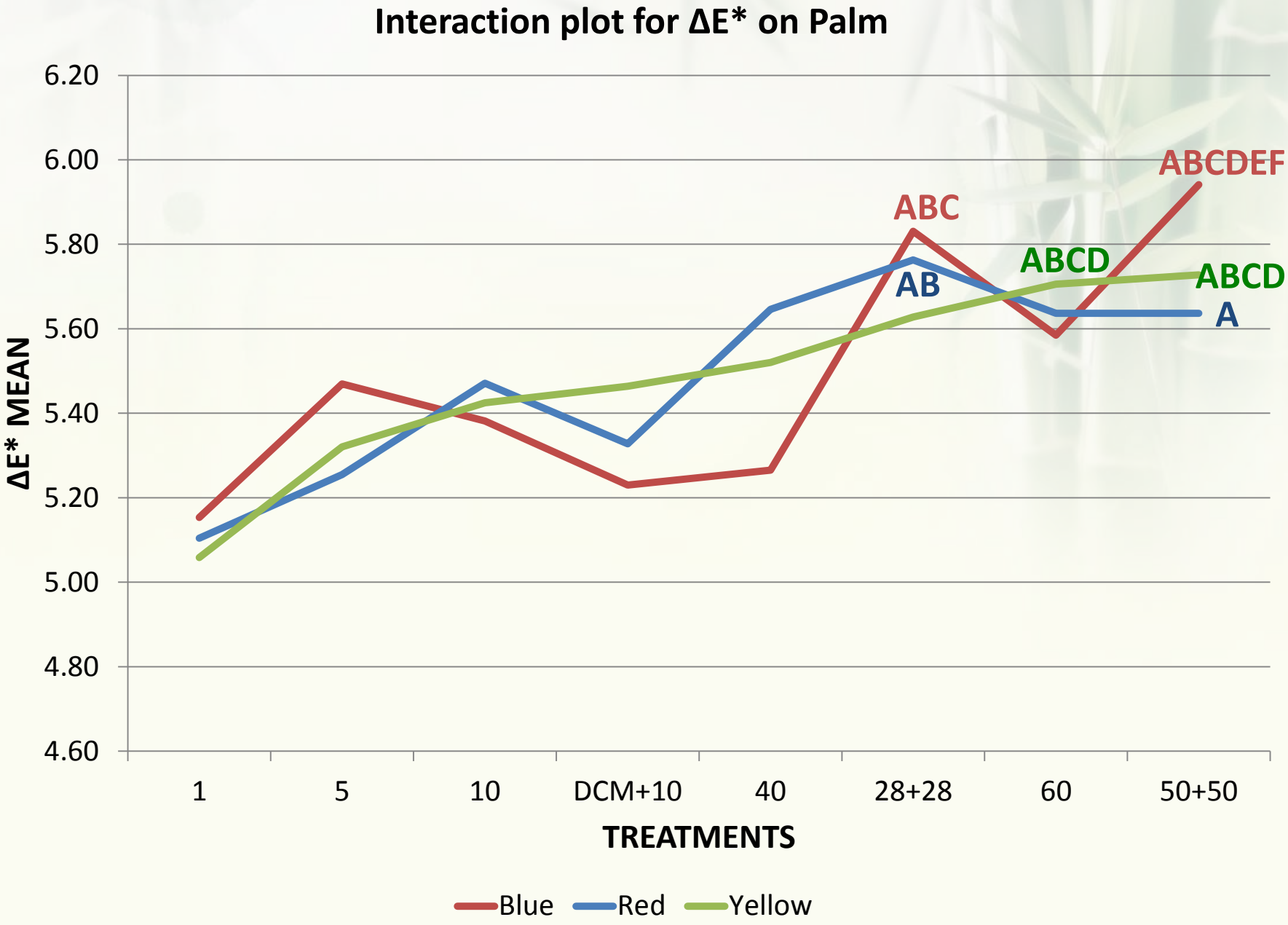
- For bamboo, no interaction was found between the color and the treatment, for that reason each of the colors was analyzed separately.
- On black palm we found that there was an interaction between pigments and treatments ($P<.0001$)


Bamboo
Palm
1
5
10
DCM+10
40
28-28
60
50-50
Y/B/R
Y/B/R


Tukey HSD for Bamboo + blue pigment
ΔE* MEAN
0
1
2
3
4
5
6
7
A
A
AB
ABC
ABC
ABC
BC
C
28-24-28
60
10
40
50-24-50
DCM+10
1
5
TREATMENTS


Tukey HSD for Bamboo + red pigment
ΔE* MEAN
9
8
7
6
5
4
3
2
1
0
A
AB
AB
BC
C
DC
DC
D
28-24-28
60
50-24-50
40
10
5
DCM+10
1
TREATMENTS


Tukey HSD for Bamboo + yellow pigment
ΔE* MEAN
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
A
A
A
AB
AB
ABC
BC
C
50-24-50
60
DCM+10
28-24-28
10
40
1
5
TREATMENTS

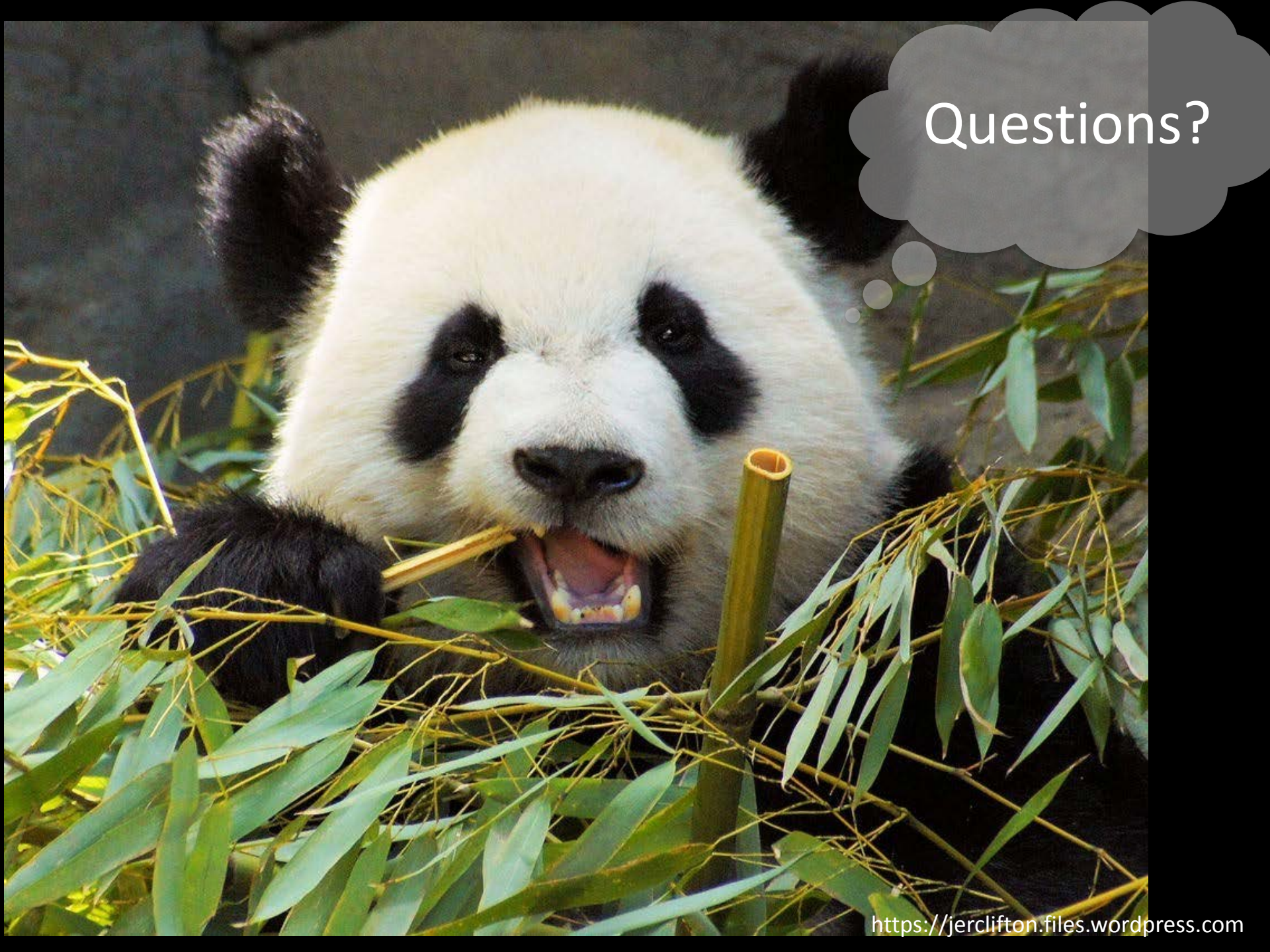

Interaction plot for ΔE* on Palm
6.20
6.00
5.80
5.60
5.40
5.20
5.00
4.80
4.60
ΔE* MEAN
ABCDEF
ABC
ABCD
ABCD
AB
A
1
5
10
DCM+10
40
28+28
60
50+50
TREATMENTS
Blue
Red
Yellow

Discussions

- The mean variation between the controls and the treated monocotyledons showed very little color variation.
- The internal pigmentation was not perceptible for the human eye, and it was not included on the final results.
- On previous publications (Robinson *et al*, 2014) it is indicated that a $\Delta E^* > 20$ is needed to perceive the color color change in wood, the same can be applied to bamboo. On this experiment the average value of $\Delta E^* = 6.16$.

Conclusions

- The highest concentrations of pigments produced the best results on bamboo and black palm.
- The highest color variation between the control and the treatment was obtained with the red pigment.
- The ΔE* values are low on both monocotyledons for all the treatments.
- Bamboo performed better in the test due to its lighter color.
- Higher concentrations of pigment could increase the color variation on monocotyledons.



https://jerclifton.files.wordpress.com

References

- Robinson, S. C., Weber, G., Hinsch, E., Vega Gutierrez, S. M., Pittis, L., & Freitas, S. (2014). Utilizing Extracted Fungal Pigments for Wood Spalting: A Comparison of Induced Fungal Pigmentation to Fungal Dyeing. *Journal of Coatings, 2014*.