QUANTIFICATION OF CHANGE IN PINTO SEED COAT COLOR AFTER AN ACCELERATED AGING TREATMENT

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Introduction

The market value of pinto beans is determined by visual appearance. Pintos that have darkened due to environmental influences before harvest or during storage lose value. A method is needed that can be used by breeders to screen genotypes for reduced darkening. Processors also need a method for evaluating multiple lots of stored beans in order to identify the best lots for specific applications. This report presents a method that makes use of tools commonly found in seed germination and food technology laboratories to quantify the potential for darkening of specific pinto bean genotypes and lots.

In the 1940s Richard Hunter developed a 3 dimensional color evaluation system. He set the lightness scale (L) to range from 0 to 100, with 0 representing black and 100 representing white. The *a* coordinate represented the location of the color on the red-green axis, with positive *a* values representing red and negative representing green. The *b* coordinate represented the location of the color on the blue-yellow axis, with positive *b* values representing yellow and negative values representing blue.[2] This method of measurement was used to eliminate errors caused by subjective visual evaluation.

Methods

Four varieties were grown in the same field and harvested at the same time near Caldwell Idaho in 2004. A sample was retained as untreated. A sample was placed under accelerated aging treatment of 41°C at 95% relative humidity for 72 hours. Seeds were placed on screens suspended over water in plastic boxes in an incubator with no light. After treatment all seeds were evaluated in a Hunter Color meter. Seeds were not germinated as they are in the accelerated aging test. L, *a* and *b* values from the color meter were recorded. The delta E calculation was used to compare changes [1].

$$\text{delta E} = [(L_2 - L_1)^2 + (a_2 - a_1)^2 + (b_2 - b_1)^2]^{1/2}$$

L = black – white axis
a = red – green axis
b = blue – yellow axis
Subscript 1 = seed from field
Subscript 2 = seed treated with high temperature and humidity

Results

Table 1 **Hunter color meter values and delta E calculations for change in pinto color**

	L (black-white)		a (red-green)		b (yellow-blue)		delta E
	X	SD	X	SD	X	SD	
Buster AA	**33.78**	**0.24**	**6.62**	**0.05**	**8.15**	**0.08**	**3.89**
Buster	**37.37**	**0.40**	**5.20**	**0.07**	**7.74**	**0.02**	
Canyon AA	**34.97**	**0.12**	**5.69**	**0.14**	**7.77**	**0.14**	**2.80**
Canyon	**37.52**	**1.27**	**4.62**	**0.14**	**7.35**	**0.29**	
Othello AA	**33.93**	**0.10**	**5.68**	**0.05**	**7.62**	**0.02**	**2.05**
Othello	**35.92**	**0.08**	**5.21**	**0.09**	**7.60**	**0.10**	
Maverick AA	**34.15**	**0.44**	**5.96**	**0.11**	**8.04**	**0.14**	**4.03**
Maverick	**38.08**	**0.05**	**5.06**	**0.14**	**7.89**	**0.18**	

X = mean
SD = standard deviation
AA = accelerated aging treatment
n = 4 measurements

Conclusions

1. The Hunter color meter can quantify pinto darkening before it can be seen by the naked eye.

2. The delta E value is a simple way to standardize color changes including darkening.

3. The accelerated aging treatment can enhance darkening in a reasonable time frame for plant breeding and for commercial evaluations.

4. Canyon descends from a cross between Buster and Othello. Its intermediate phenotype is not explained by single gene control of the pinto darkening trait.

References

1 Hunter, RS and Harold RW 1987 The Measurement of Appearance 2nd ed. John Wiley and Sons, New York

2 HunterLAB. Application Notes, Insight on Color August 1-15, 1996, Vol. 8, No. 9