SOIL COLORS AND THEIR INTERPETATION MARCH 2014

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OBJECTIVES

- Define and describe methodology for determination of soil color
- Describe proper use of Munsell color book
- Describe methodology for determination of soil color contrast

NOTE

Additional information on certain slides will be found in the “NOTES” section and will only be visible in the “normal” view in PowerPoint

Required Methodology

United States Department of Agriculture

Natural Resources Conservation Service

(USDA NRCS)

USDA NRCS Notation

- Officially referenced by DOH regulations
- MUST be used for all OSTDS purposes when describing soils
- No other methodology acceptable

Methodology Describes:

- Soil Color
- Soil Texture (different presentation)
- Soil Horizonation (layering of soils, different presentation)
- Seasonal high water table indicators

Soil Color

- Color: A key property in soil interpretation
- Most evident (observable)
- Influenced by Organic Matter (OM) content and redoximorphic (redox) sensitive metals such as Iron (Fe) and Manganese (Mn)

Munsell Color Charts

Properly Coloring Soils

Munsell Coloring Information

- Current version is 2009
- Can use older books if they contain the requisite information and are like new
- Any page with missing, faded, cracked or discolored (dirty) chips must be replaced
- Using improper tools will result in wrong answers, possibly a system in violation of regulations

Munsell Color Notation

- Used to describe soil color for maximum accuracy and communication
- Three descriptive elements are used and are always written in the following specific order and manner
- HUE VALUE/CHROMA
- 5YR 4/6

Munsell Notation - Hue

- Basis spectral color such as red, yellow, yellow-red, purple, blue, green, green-yellow, etc.
- Munsell book normally has one hue per page, except for the Gley Charts (plus two other pages that we will not cover)

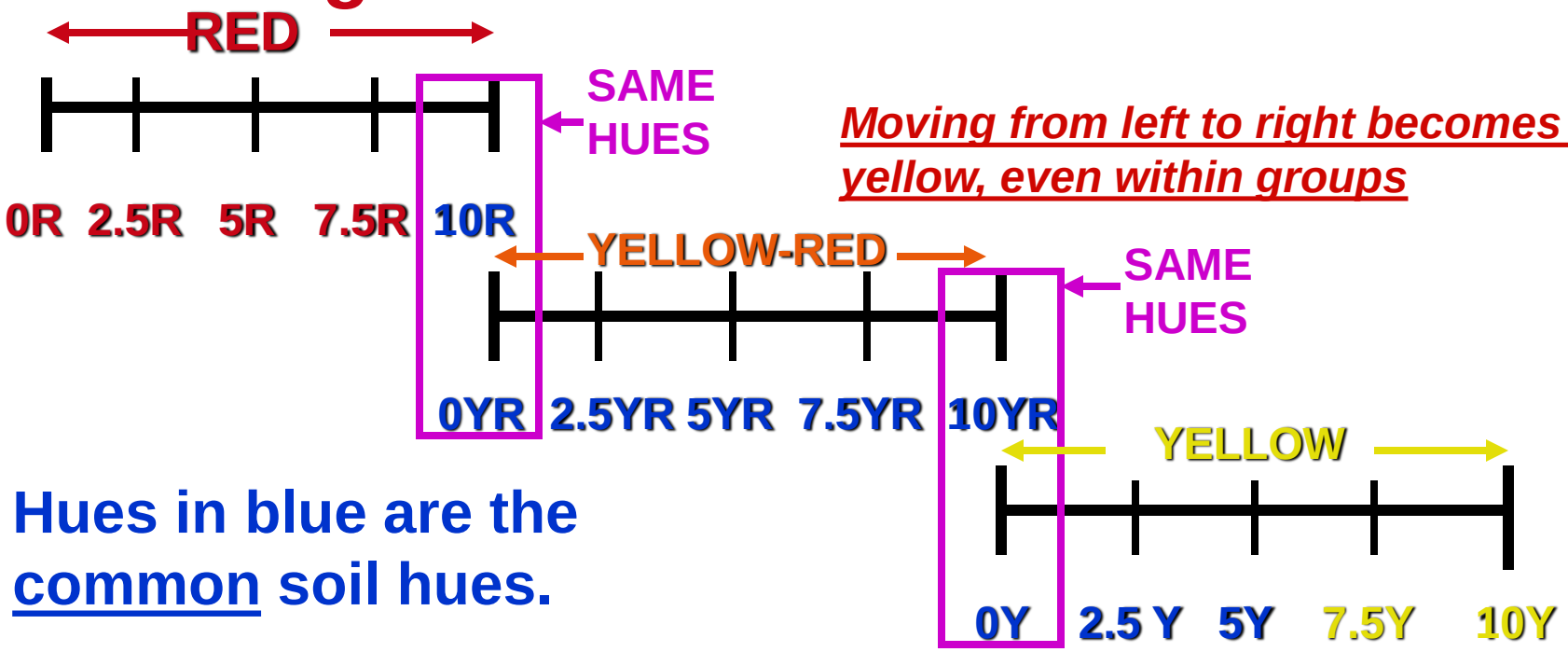
HUE Symbols

- R = Red; YR = Yellow-Red; Y = Yellow
- The letter is preceded by numbers 0 to 10
- Within each letter range the Hue becomes more yellow and less red as the numbers increase

Hues

- For example:
  - 5YR is more red (less yellow) than 7.5YR
  - 2.5Y is less yellow than 5Y
- Gley Charts include Neutral, Yellow, Green, Blue, Purple, and combinations

Hue - basis spectral color; wavelength



Moving from left to right becomes more yellow, even within groups

Hues in blue are the common soil hues.

Note increments of 2.5 between each consecutive hue (this is one unit of hue)

Common Soil Hues

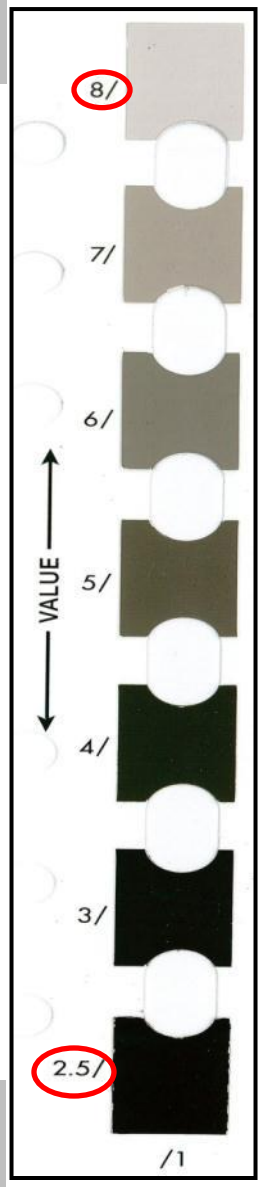
In order from most red to most yellow:

- 10R
- 2.5YR, 5YR, 7.5YR, 10YR
- 2.5Y, 5Y

Munsell Notation-VALUE

- *Indicates the degree of lightness or darkness, or reflectance* of an object viewed in daylight
- Scale is from *0 for the ideal black to 10 for the ideal white*, in steps (units) that are visually equal
- Full scale not generally used for soils

PURE WHITE 10/0



GRAY 5/0

PURE BLACK 0/0

Value-Lightness increases from black at the bottom of page, through the grays, to nearly white at the top of the page

Munsell Notation-Chroma

- *The scale is from 0 - 8 on the Munsell Color Chart*
- 0 indicates no strength of color (no color; gray) and 8 greatest strength (most color)
- Full scale not generally used for soils
- Numbers are units of Chroma

Chroma

- Read from left (least color) to right (most color)
- *The color intensity or relative strength of color,* indicates the degree of departure from a gray of the same Value
- Color is from coloring agents like iron or manganese

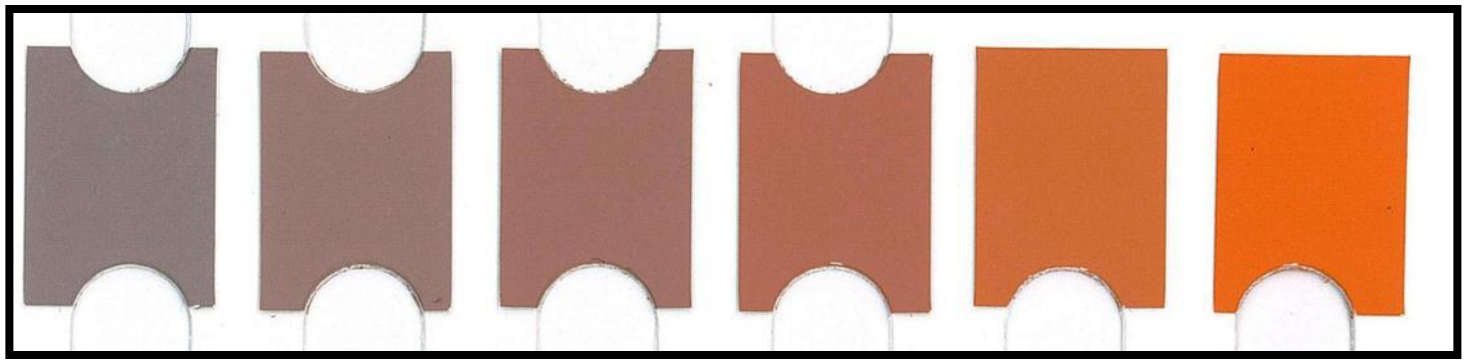
Chroma – color intensity

"Neutral" Color

"Pure" Color

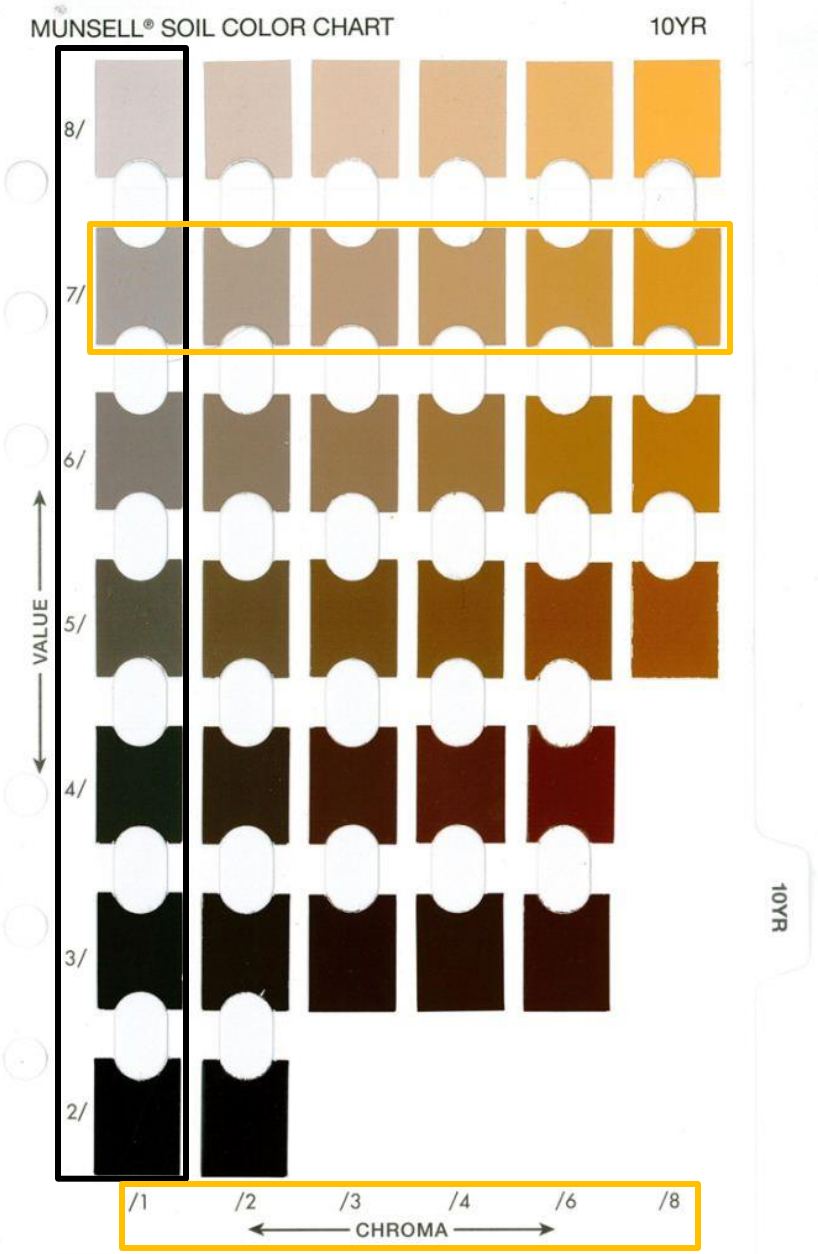
1 2 3 4 6 8

Increasing strength of color (at same Value)



Increasing grayness

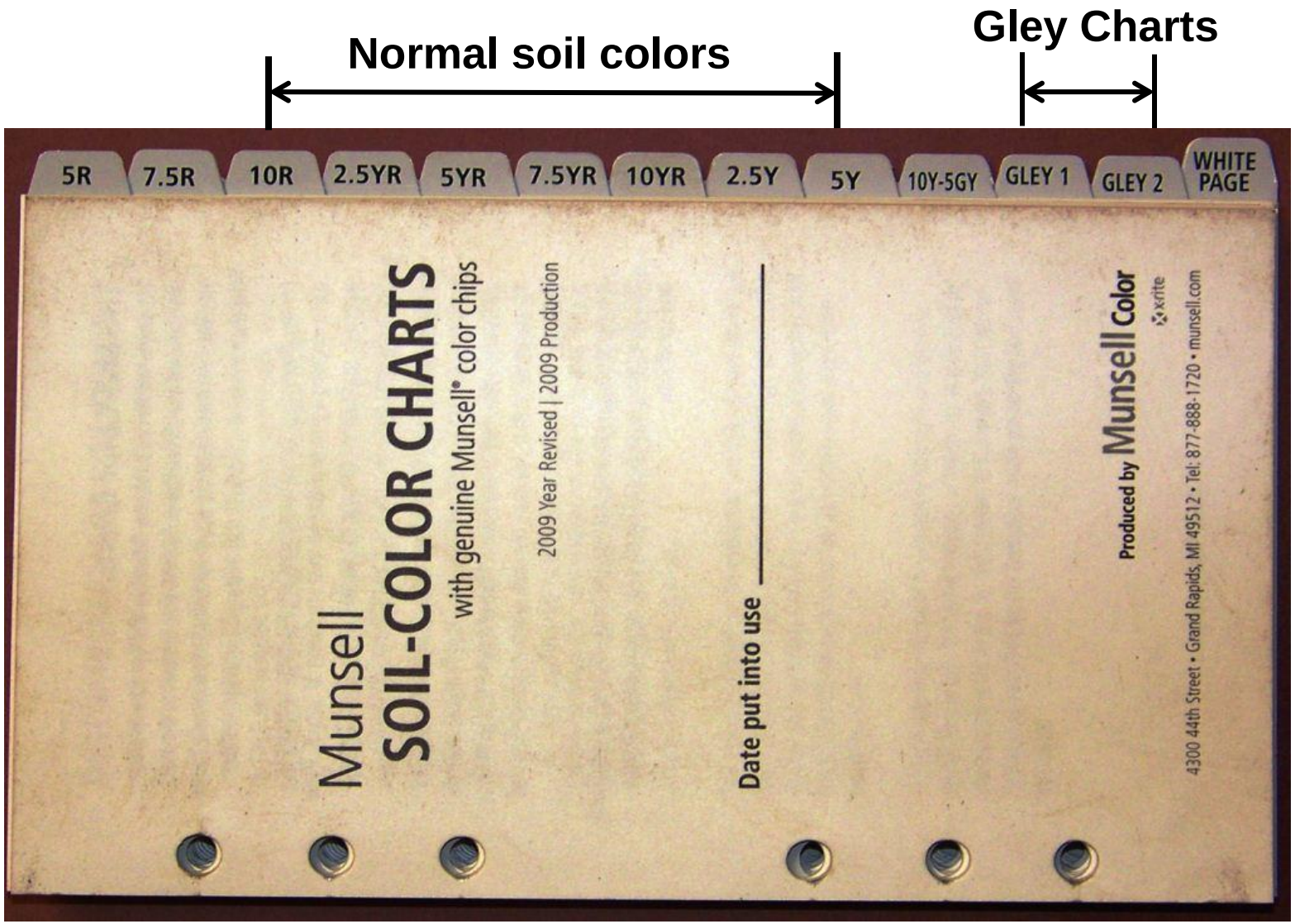
Value - measurement of soil organic matter (OM), the lightness or darkness of a color. Range is from 0 (pure black) to 10 (pure white).



Chroma- measurement of coloring agents like iron or manganese. Strength of color. Range is from 0 (no color) to 8 (most color).

Munsell Book Layout

- Pages in Munsell Book are prearranged from most red through most yellow
- Gley Charts are in normally found in back


Normal soil colors
Gley Charts
5R
7.5R
10R
2.5YR
5YR
7.5YR
10YR
2.5Y
5Y
10Y-5GY
GLEY 1
GLEY 2
WHITE PAGE
Munsell
SOIL-COLOR CHARTS
with genuine Munsell® color chips
2009 Year Revised | 2009 Production
Date put into use _____
Produced by Munsell Color
4300 44th Street • Grand Rapids, MI 49512 • Tel: 877-888-1720 • munsell.com

Munsell Book Use

- Use the book properly – Pages must be usable
- Use book as it came from manufacturer
- Do not rearrange pages
- Must have clean chips, pages as they originally came
- Do not laminate chips, take pictures of the page for use, etc.

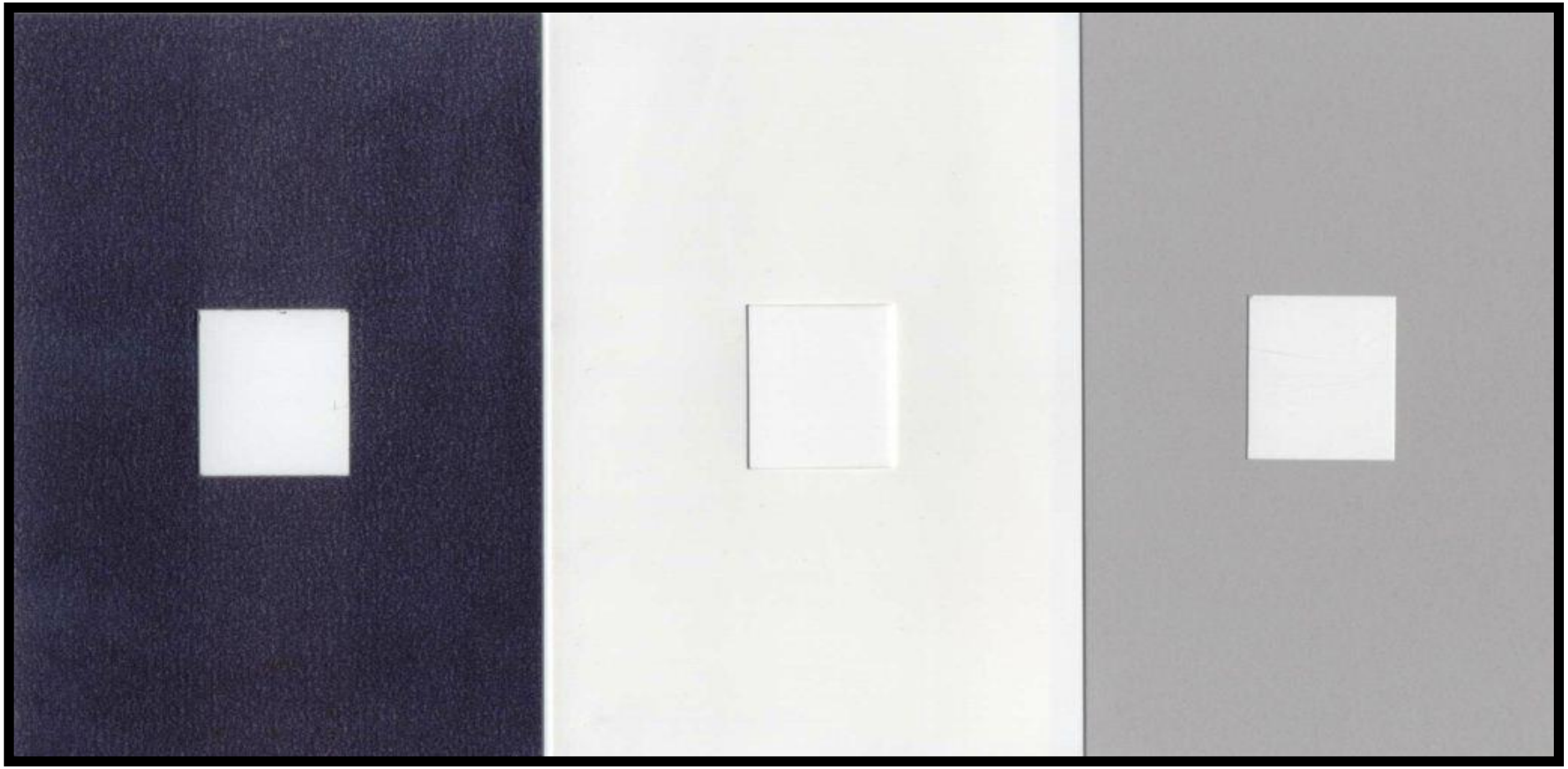
Munsell Book Use

- Do not take too long to read the color
- Use the *Chip Masks* if necessary
- Chip masks facilitate color matching when there is difficulty in choosing a color

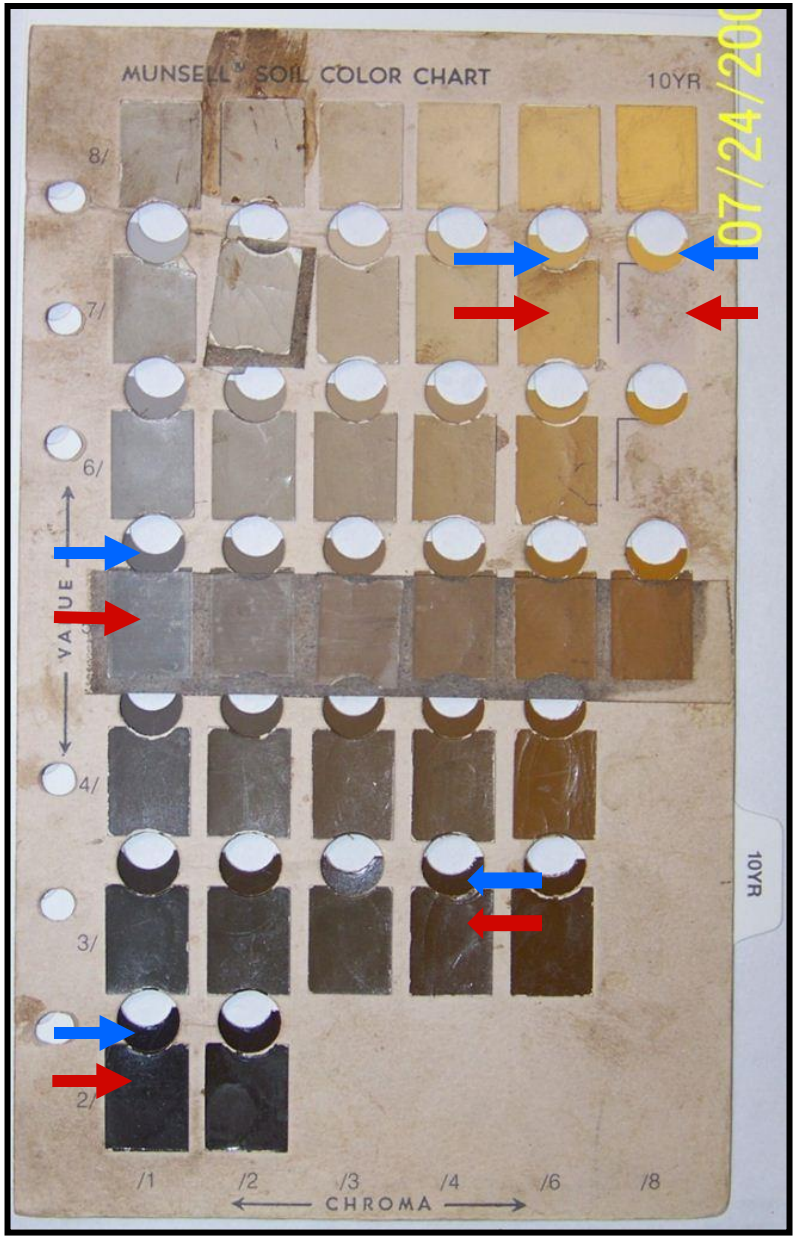
Munsell Book Use-Chip Masks

- Three masks, use mask closest in value to soil sample
- Black mask for black/very dark samples
- White mask for light colored samples
- Gray mask for all others

CHIP MASKS



Taped chips, missing chips, cracked chips, discolored (dirty/faded) chips. Older page on left, new on right.

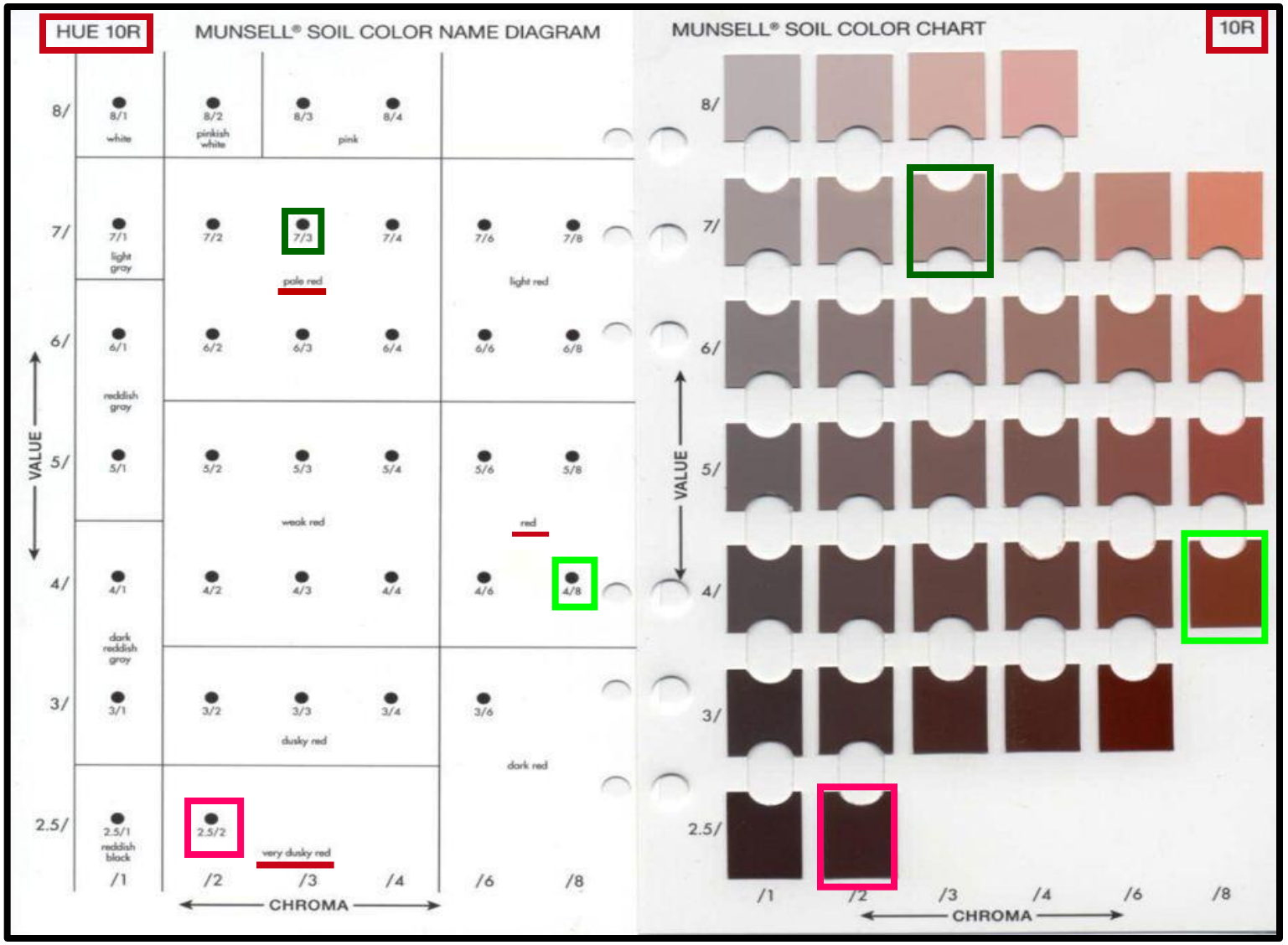


Comparison of 2 cards (New behind old. Observe differences in chip colors)

Correct Coloring Method

- Look to left side of Munsell book for soil color name and match Hue Value/Chroma from right side
- See next slide for examples

Soil Color Names



Colors BETWEEN Chroma Chips

- Colors exist between chroma chips
- They are noted differently than others
- If the chroma is between two chips, note the lower one (more gray) and add a “+” as a notation
- Do not round up or down

Colors BETWEEN Chroma Chips

- Example: The soil sample has more chroma than 10YR 6/1 but not enough to be 10YR 6/2
- The proper notation would be 10YR 6/1+
- This will be discussed in more detail later

QUESTIONS??

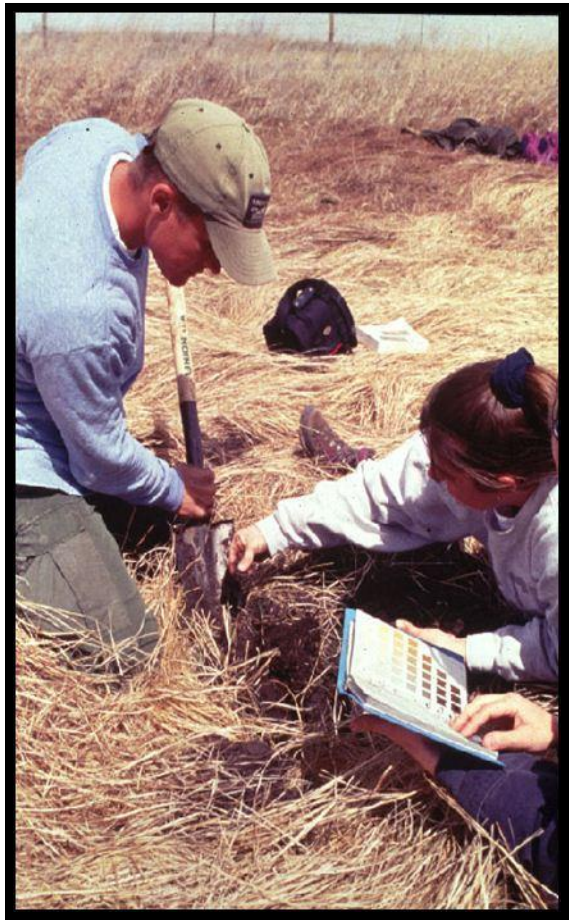
PROPER TECHNIQUE FOR DETERMINING SOIL COLORS

Correct Coloring Method

- Hold soil behind the hue card containing the color chips (the right side of the Munsell Book)
- Never put soil on front of pages
- Find the closest match from *all* choices in the book, read Hue Value/Chroma notation

Reading soil colors

- Optimum conditions
  - Natural light
  - Clear, sunny day
  - Midday
  - Light at right angles
  - *Soil is moist (not wet or dry)*



Moist Soil

- *Does not glisten or have puddled water*
- *Doesn't darken when moisture added*
- *When texturing, the soil should be easily manipulated by your thumb and forefinger*
- In non-sandy soils, this could be compared to moist putty

Correct Moisture Content

DRY SOIL

Note higher value, lower chroma

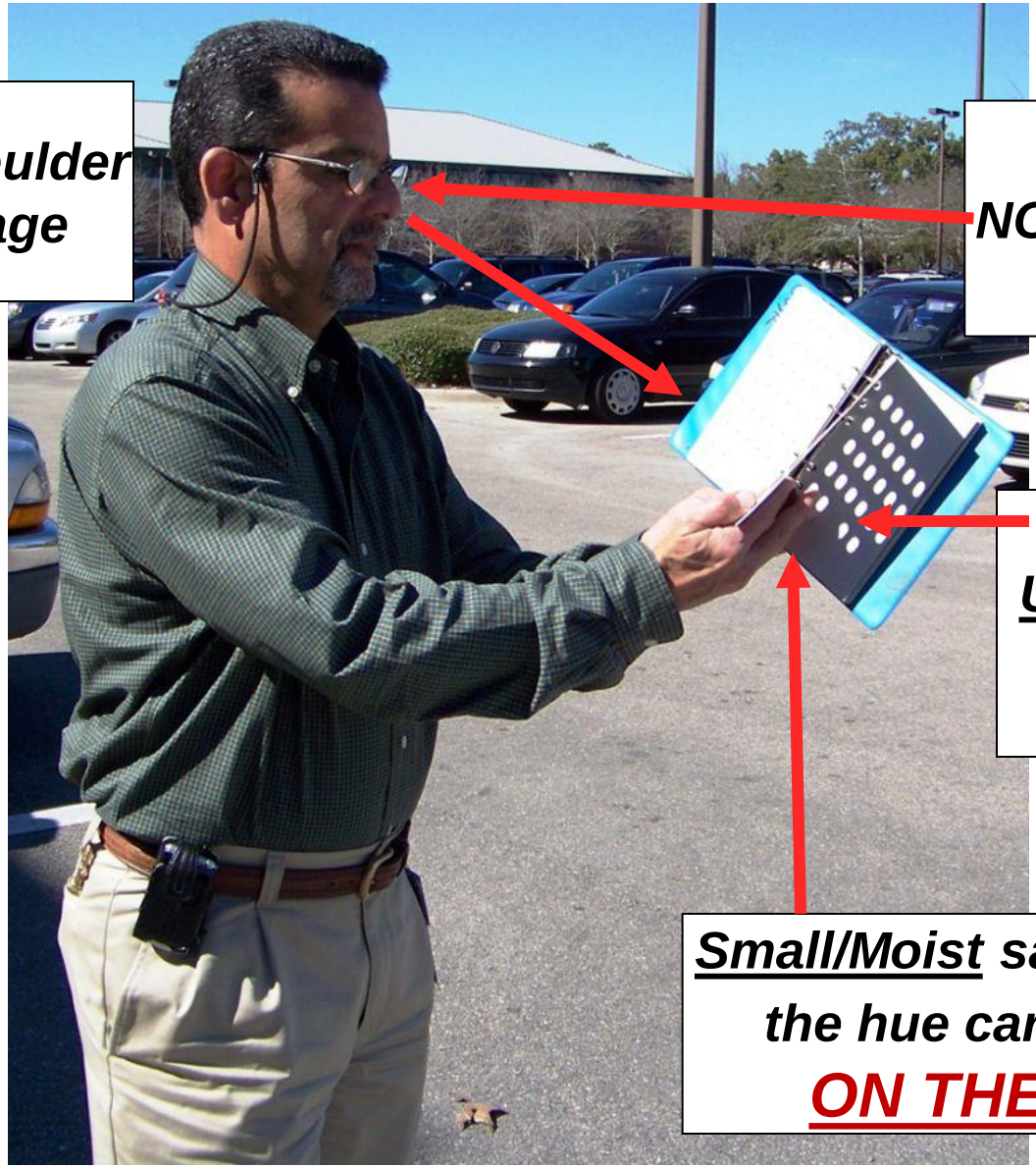
MOIST SOIL

MUST USE THIS ONE

TOO WET

Note Glistening

Sun over RT shoulder
RT angle to page

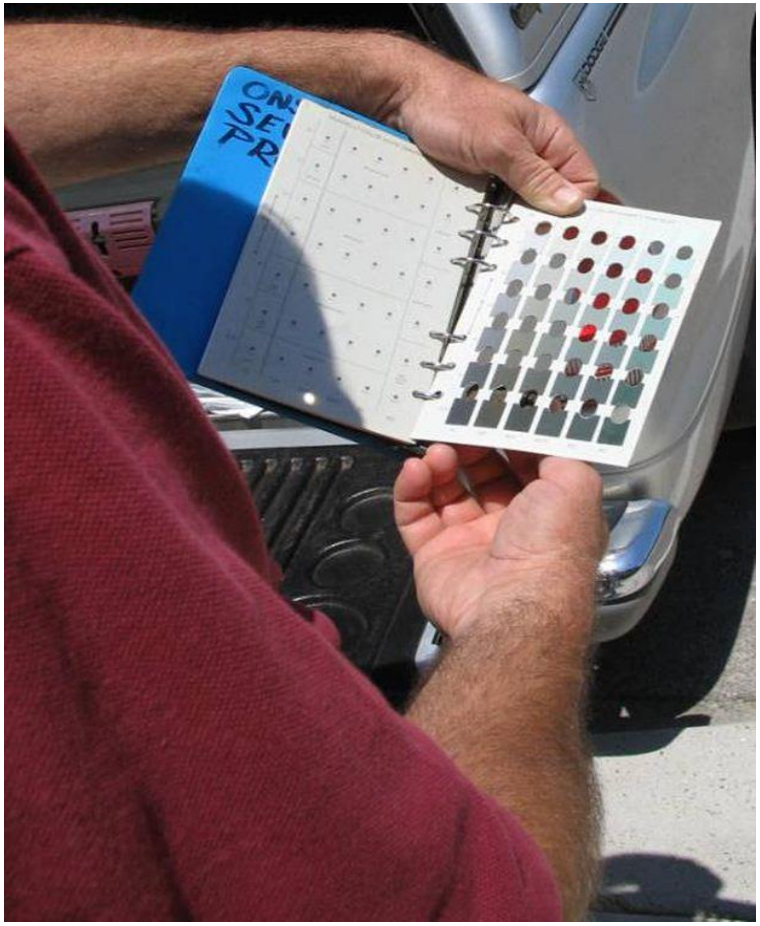


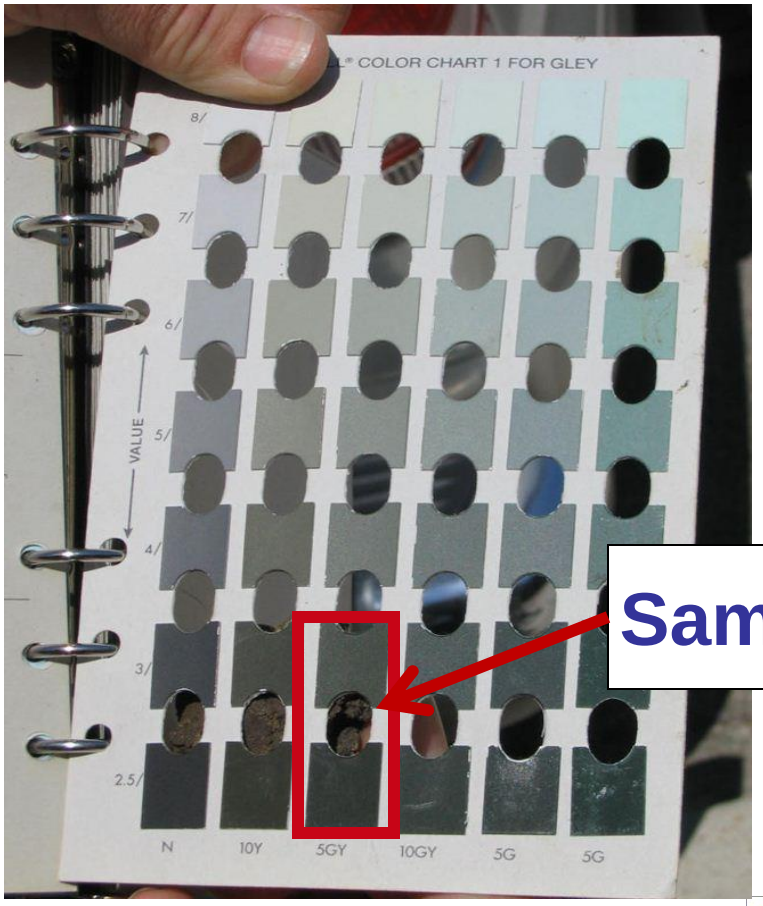
NO Sunglasses!!!

Pages are <u>UNALTERED/ ORIGINAL/ CLEAN</u>

<u>Small/Moist</u> sample <u>BEHIND</u> the hue card! <u>NEVER ON THE PAGE!!</u>

Sample is behind the hue card





Incorrect Methodology

Low Chroma Colors

- Whenever the phrase “low chroma” is used it means that the chroma of the color is ≤2
- Translates to very little coloring agent except for organic matter

Low Chroma and Gley Colors

- Gley Chart colors are all low chroma colors
- *Specific* gley colors have meaning regarding the SHWT determination

Gley Charts and Their Correct Use

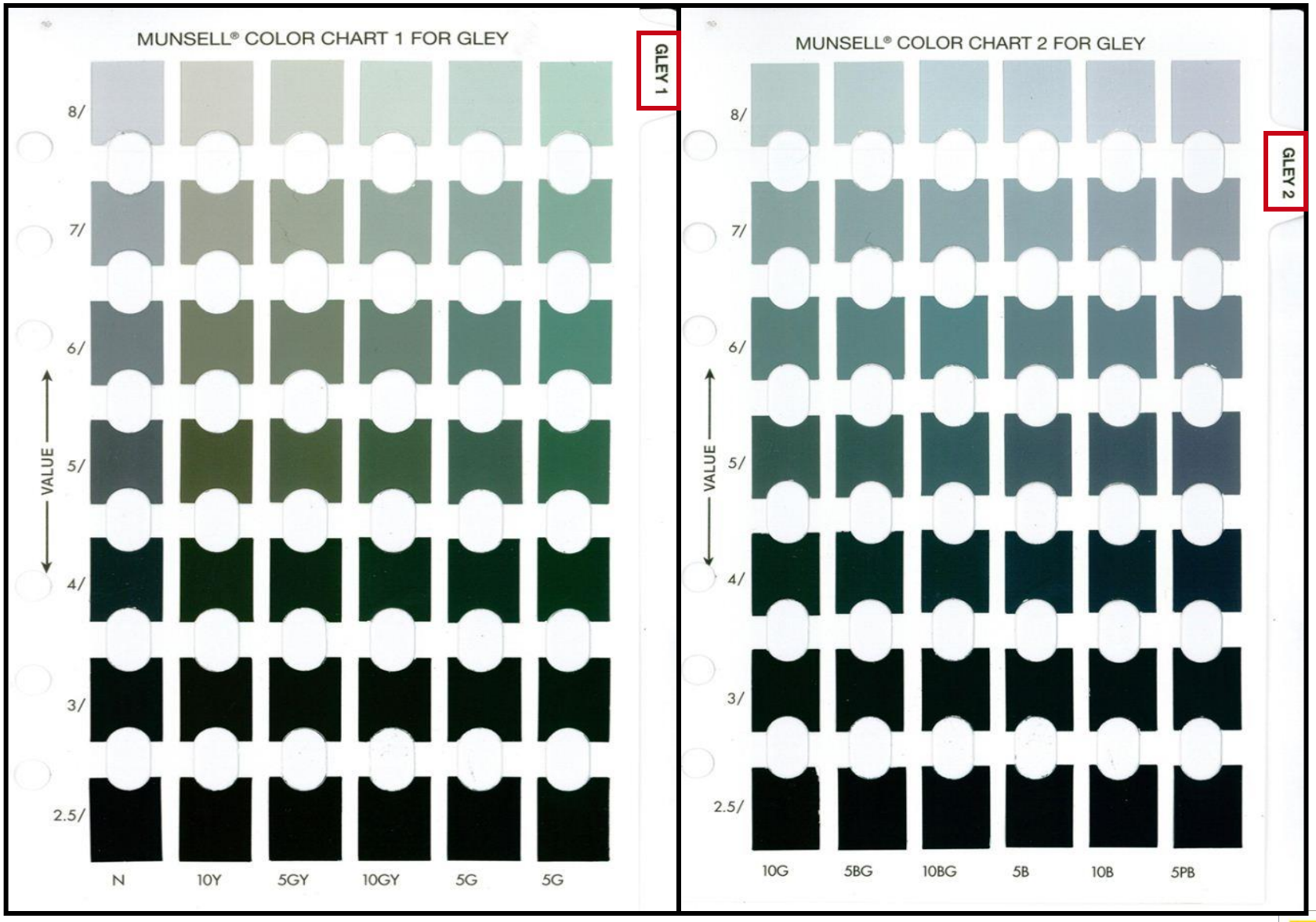
Different than all other pages

GLEY CHARTS

- Two supplemental charts containing grayish, bluish and greenish colors *often found in very wet mineral soils* are contained on these charts
- The charts also contain a Neutral Hue (labeled N) which means no chroma
- *Soils with specific colors on these charts are very wet and determine the SHWT*

Gley Chart Colors

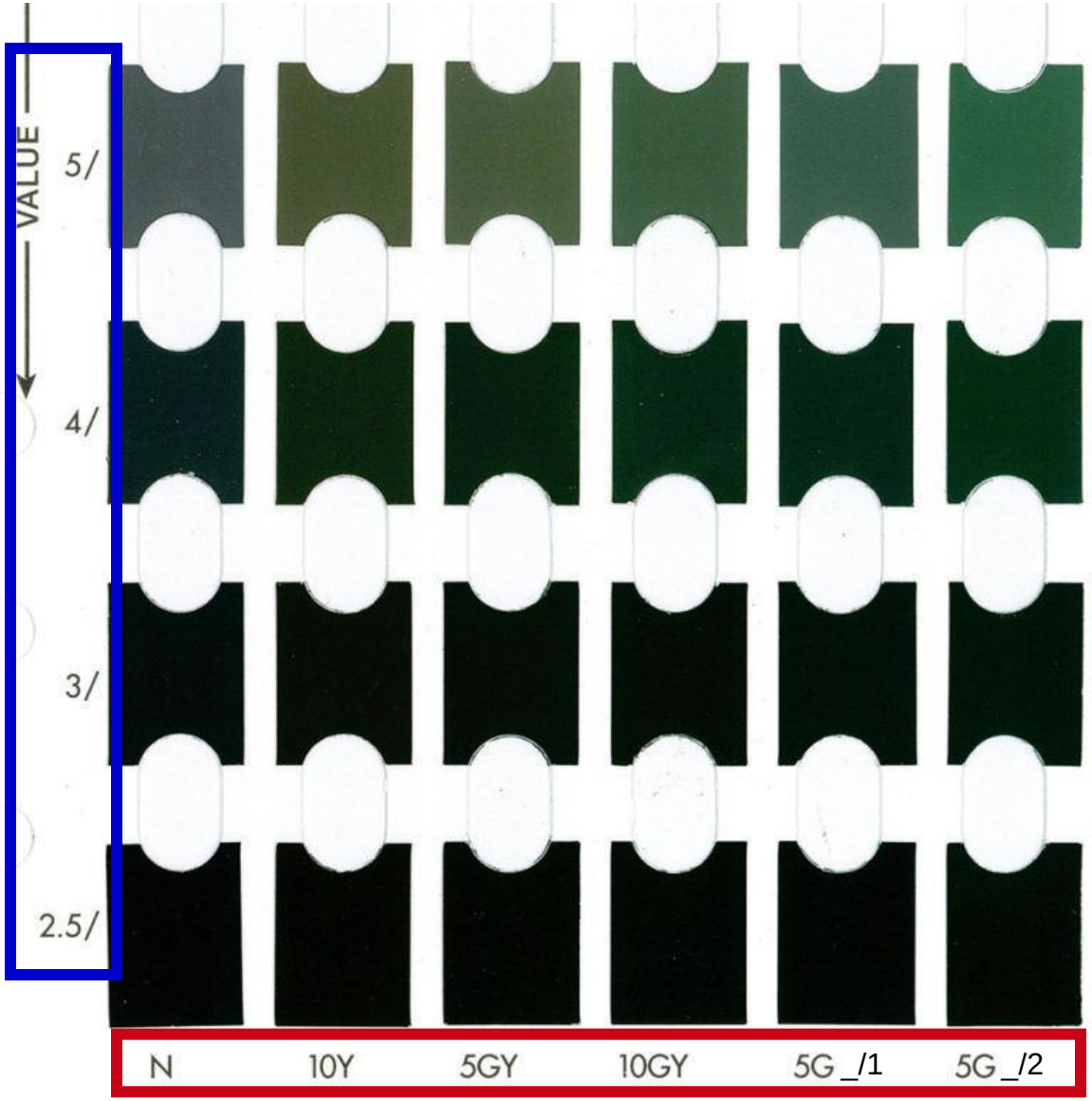
- Neutral (N)
- Yellow (Y)
- Green (G)
- Blue (B)
- Purple (P)
- Green-Yellow (GY)
- Blue-Green (BG)


MUNSELL® COLOR CHART 1 FOR GLEY
GLEY 1
8/
7/
6/
5/
4/
3/
2.5/
VALUE
N
10Y
5GY
10GY
5G
5G
MUNSELL® COLOR CHART 2 FOR GLEY
GLEY 2
8/
7/
6/
5/
4/
3/
2.5/
VALUE
10G
5BG
10BG
5B
10B
5PB

The Gley Charts

- Hues are found in each individual column at the bottom of the page
- Values are read like other charts
- Chromas not evident on color chips (with two possible exceptions depending on the version being used)

Values

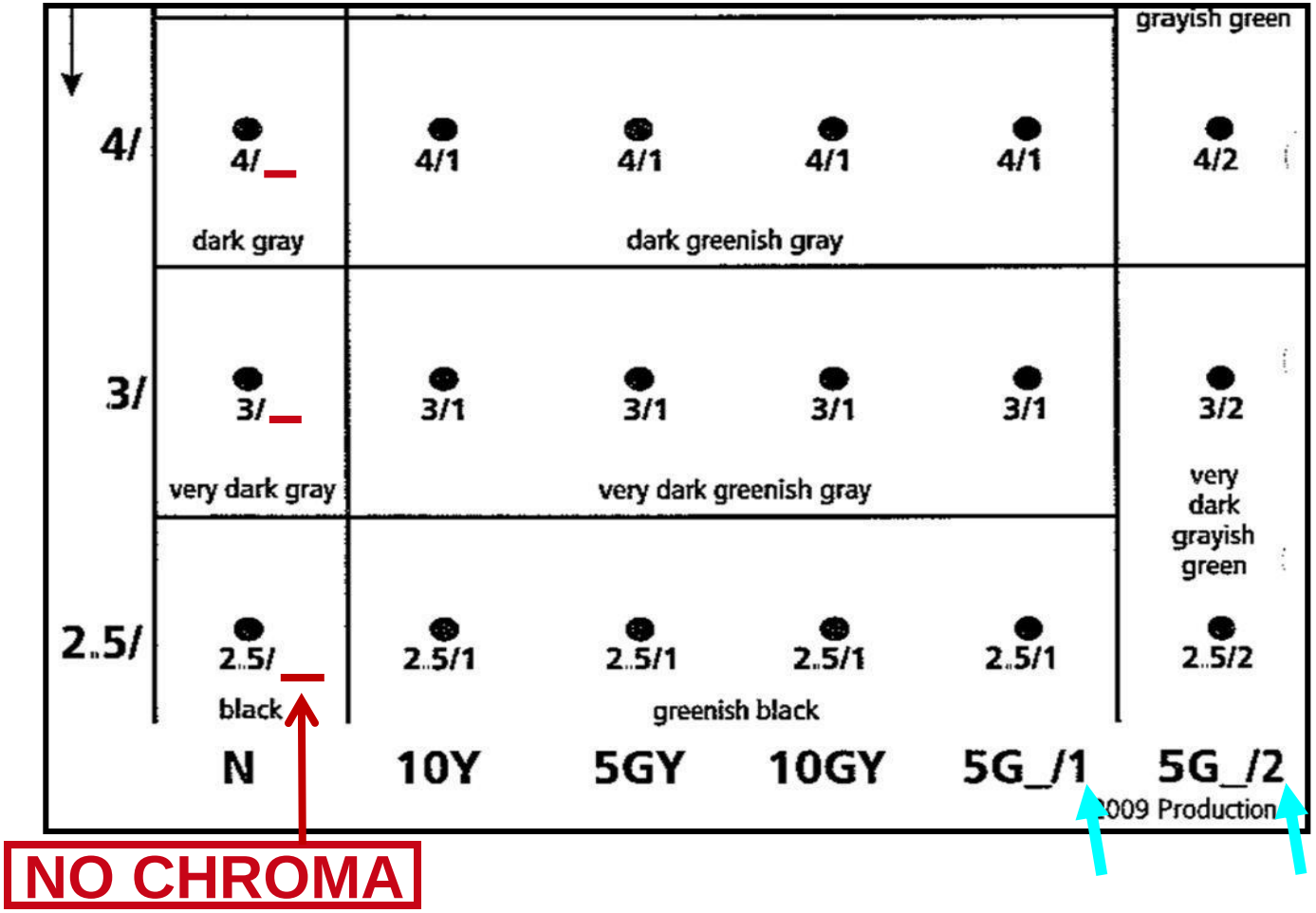


Different Hues on bottom

Chromas for Gley Charts

- Read chroma from the English name (left side) of the charts
- Chroma designation will be to the right of the forward slash like all other chromas

Chroma read to right of forward slash



Gley Chart Chromas

- All chromas on Gley Charts are chroma 1, except for two hues:
- N (Neutral) having 0 (*no*) chroma (this is due to lack of iron giving any color)
- 5G _/2

Soil Color Contrast

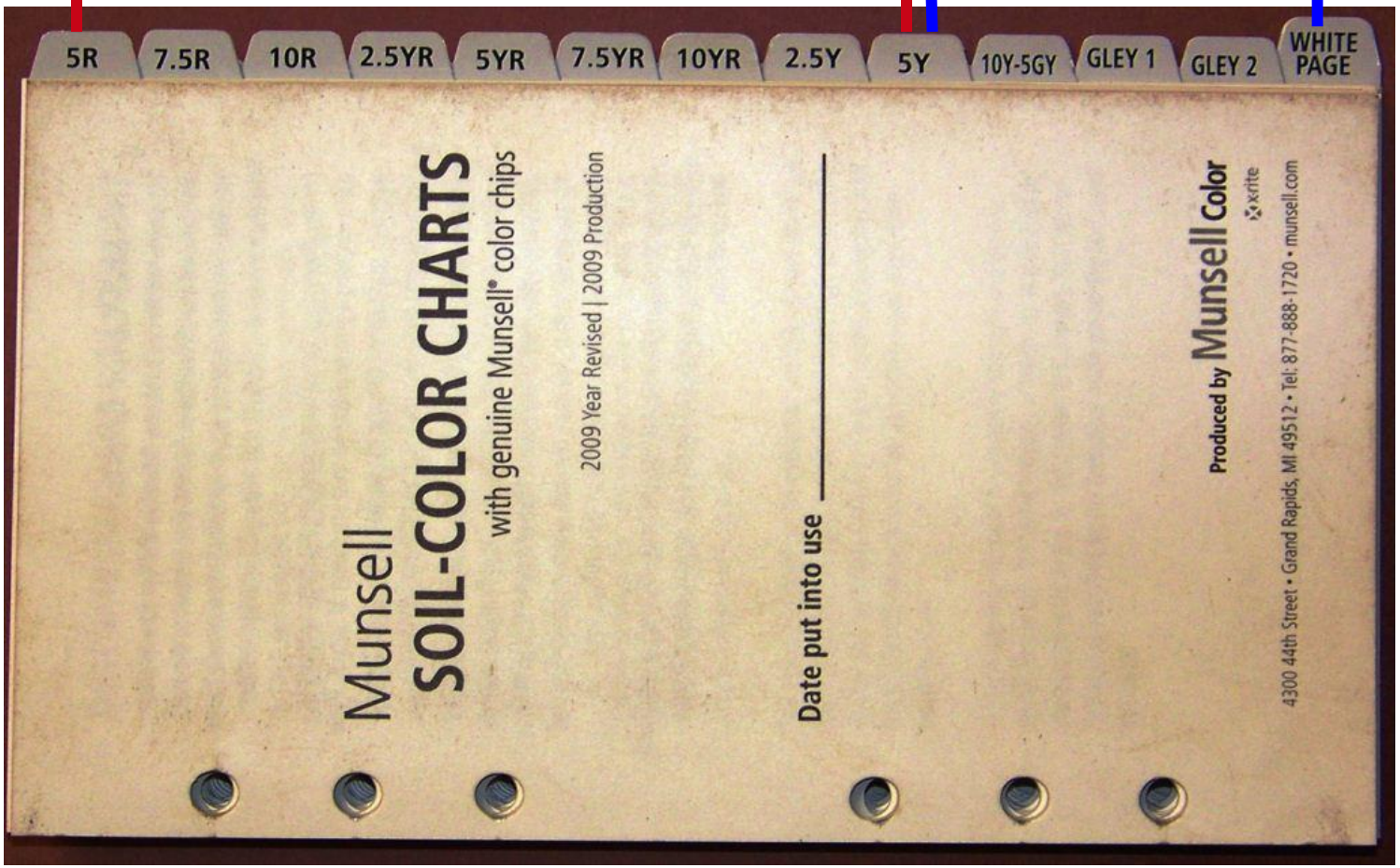
Determining Differences between soil colors

Compare Components Correctly

- Compare Hue to Hue-ignore value and chroma color components
- Compare Value to Value-ignore hue and chroma color components
- Compare Chroma to Chroma-ignore hue and value color components

Hue Difference

- First must determine the difference in the HUE of each color
- Use color wheel (later slide)
- Quick method for most colors is to count pages in accordance with following diagram. (Note: Δ signifies “change in” and “h” signifies Hue; therefore Δh means change in Hue)


Δh=1 per page, count # of pages
Δh≠1 per page
5R
7.5R
10R
2.5YR
5YR
7.5YR
10YR
2.5Y
5Y
10Y-5GY
GLEY 1
GLEY 2
WHITE PAGE
Munsell
SOIL-COLOR CHARTS
with genuine Munsell® color chips
2009 Year Revised | 2009 Production
Date put into use _____
Produced by Munsell Color
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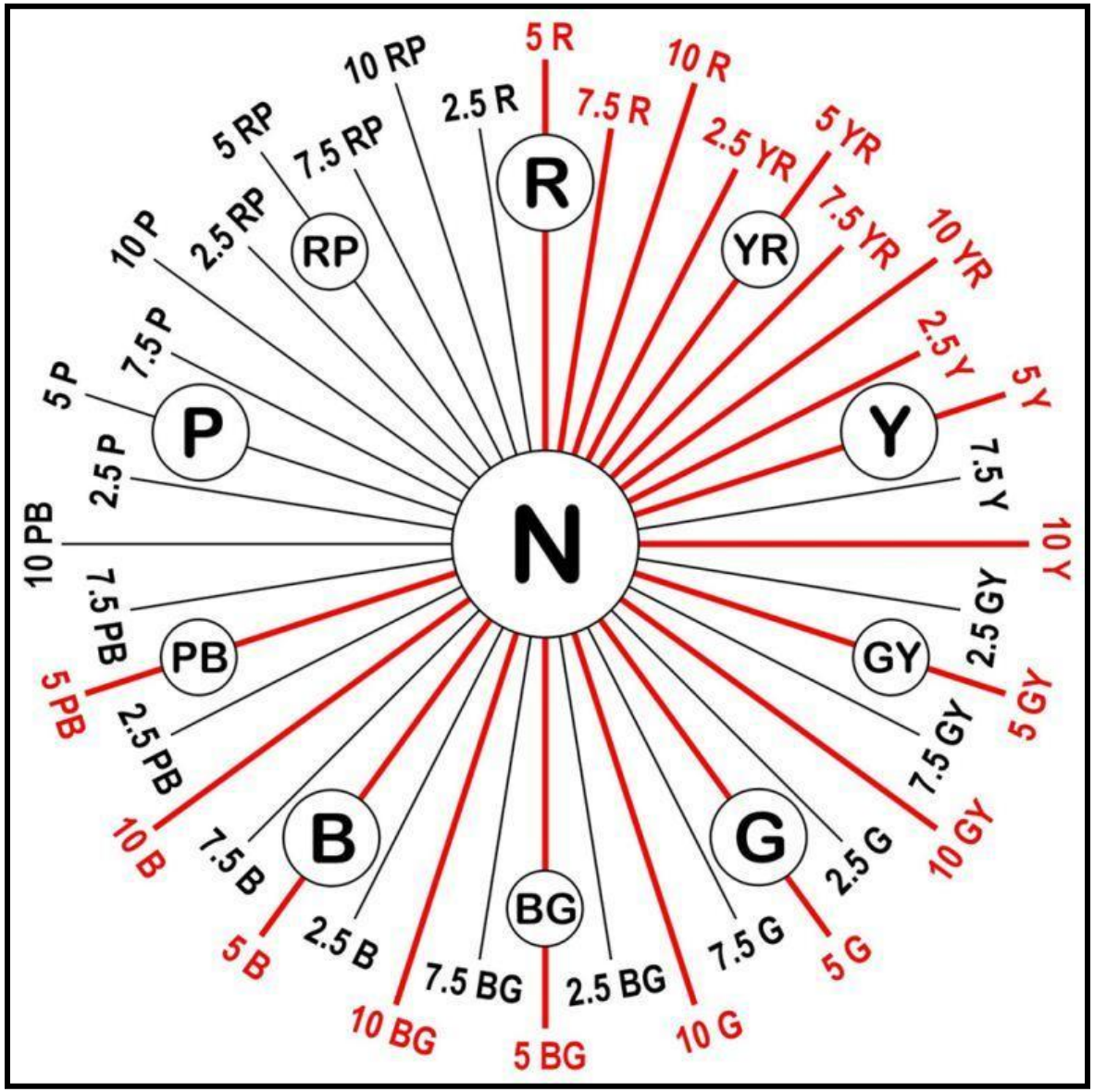
Use of the Munsell Hue Circle

USDA NRCS Technical Note 2

Munsell Hue Circle

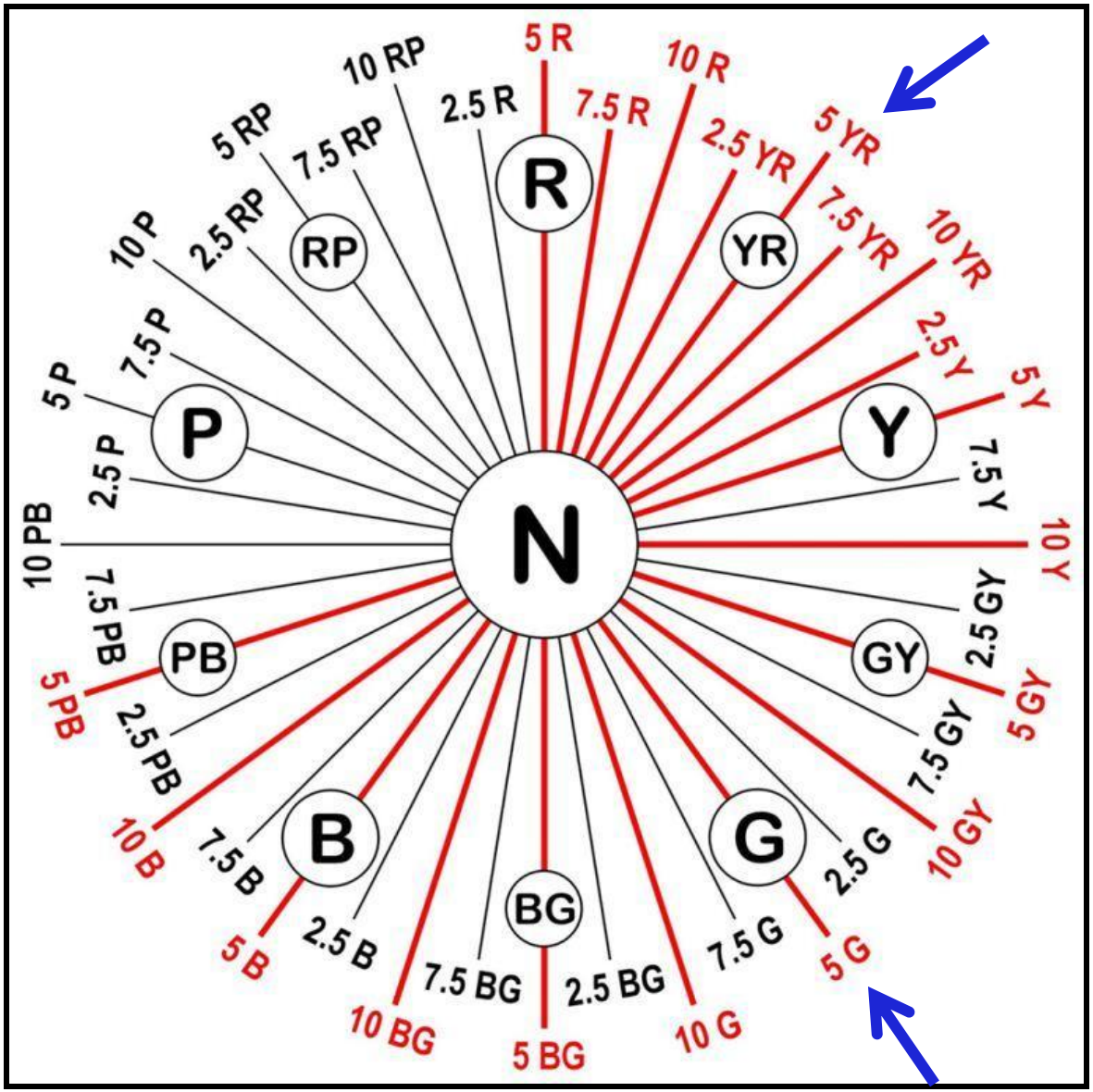


To calculate Hue Change:

- *Count the number of 2.5-unit intervals*
- 2.5YR and 7.5YR differ by two 2.5-unit intervals (7.5-2.5=5, which is two 2.5-unit intervals), therefore Δh=2
- Hues of 5Y and 5GY differ by four 2.5-unit intervals, therefore Δh=4
- *Could also just use the wheel*

Counting Hue Change

- Count the number of hues as you go CLOCKWISE on wheel
- Example: Difference between 5YR and 5G is a difference of 12 hue units
- Consider ONLY the Hue information, ignore value/chroma information


N
R
5 R
7.5 R
10 R
2.5 R
10 RP
5 RP
7.5 RP
2.5 RP
RP
10 P
5 P
7.5 P
2.5 P
P
10 PB
7.5 PB
5 PB
2.5 PB
PB
10 B
7.5 B
5 B
2.5 B
B
10 BG
7.5 BG
5 BG
2.5 BG
BG
10 G
7.5 G
5 G
2.5 G
G
10 GY
7.5 GY
5 GY
2.5 GY
GY
10 Y
7.5 Y
5 Y
2.5 Y
Y
10 YR
7.5 YR
5 YR
2.5 YR
YR

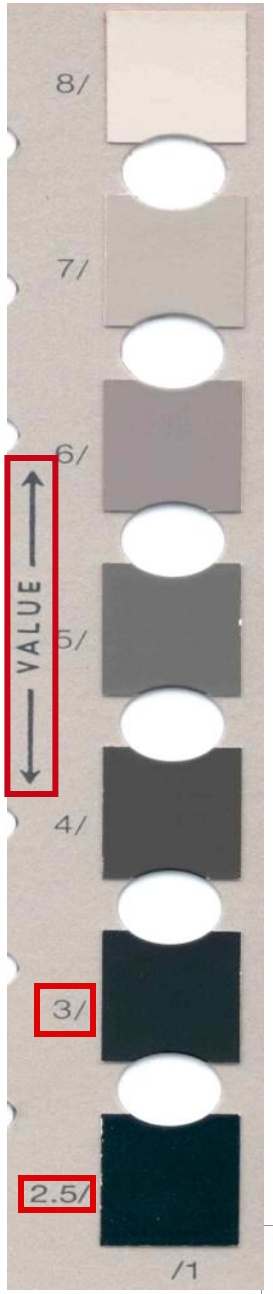
Hue change from Neutral

The Hue change from neutral to any other hue is a change of one unit of hue

Units of Value Change

- Units of value range from 0 to 10
- Normally have one unit of change between each stated value, but there may be less
- Example:
- The difference in Value between a 10YR 5/1 and a 10YR 7/1 is 2 UNITS. (The difference between 5 and 7 is 2)

- Values can change by as little as 0.5 units
- Difference between a value of 2.5 and a value of 3 is <u>0.5 units</u> (<1 unit of value change)
- If you were to count chips, the answer would appear to be 1, which would be <u>*wrong*</u>
- <u>Don't count chips</u>

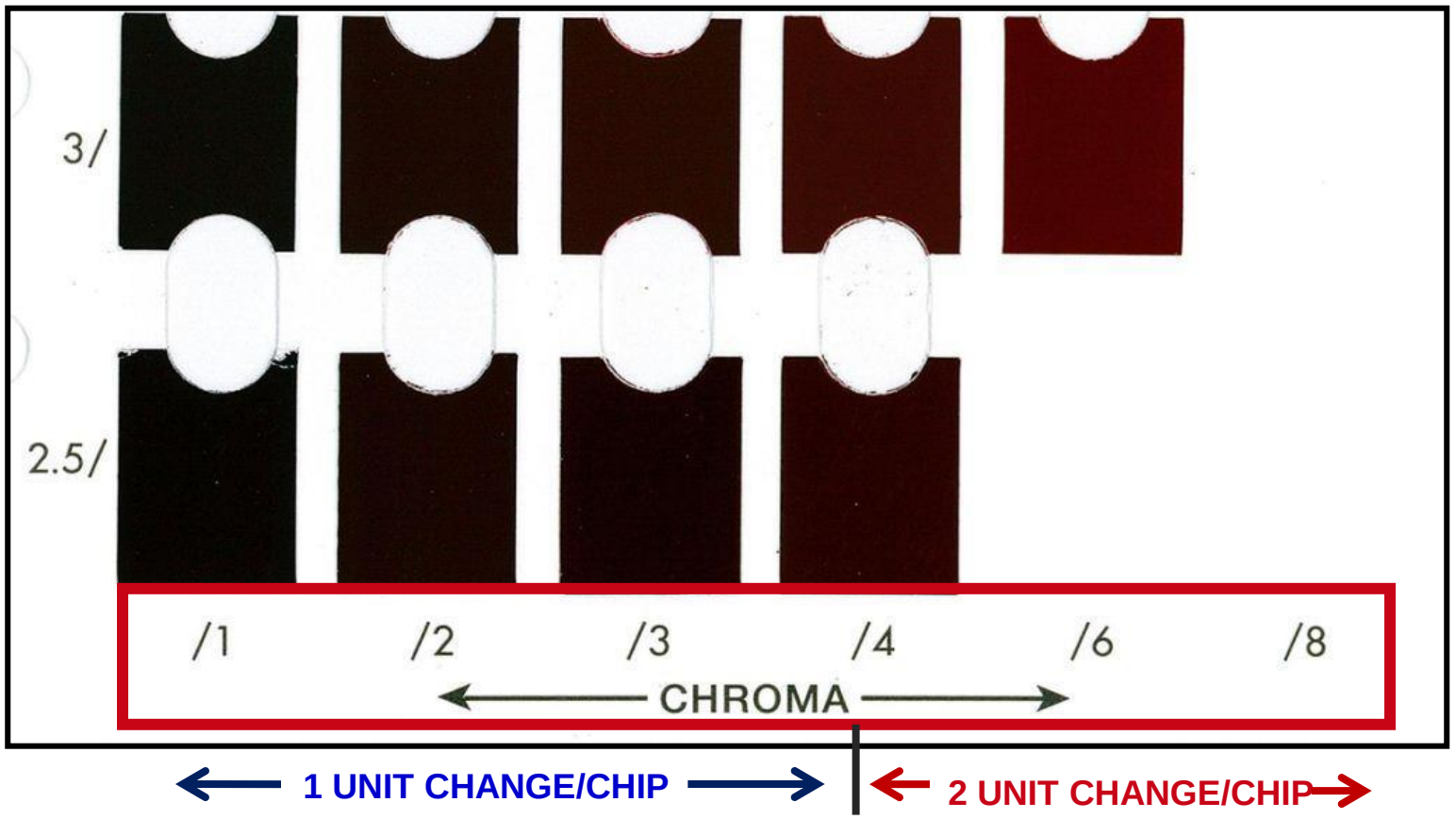


TO DETERMINE <u>VALUE CHANGE</u>, CALCULATE DIFFERENCE BETWEEN THE UNITS (Value of 2.5, 3, 4, etc.) –

Units of Chroma Change

- Units for Chroma range from 0 to 8
- There is a one or two unit change between each chroma in the soil color book
- Exception would be if you fall between two chromas such as a chroma 2 and 2+ (as in stripped matrix)

Units of Chroma Change



Units of Chroma Change

- The difference in Chroma between a 10YR 5/3 and a 10YR 5/*6* is 3 units (6-3=3)
- Counting chips would lead to conclusion of a two chip difference which is the wrong answer
- Chroma change would be counted as 3
- *Do not count chips!!!*

TO DETERMINE CHROMA CHANGE, CALCULATE DIFFERENCE BETWEEN THE UNITS (Chroma of 1, 2, 3, 4, etc.) –

- When determining the soil color difference, c*ompare* *Value to Value* *and Chroma to Chroma*
- Change in hue does not affect the calculation of the difference between values or chromas, they are independent of each other
- Simply determine the value or chroma in each color and calculate the difference without regard to hue

QUESTIONS?

Soil Color Contrast

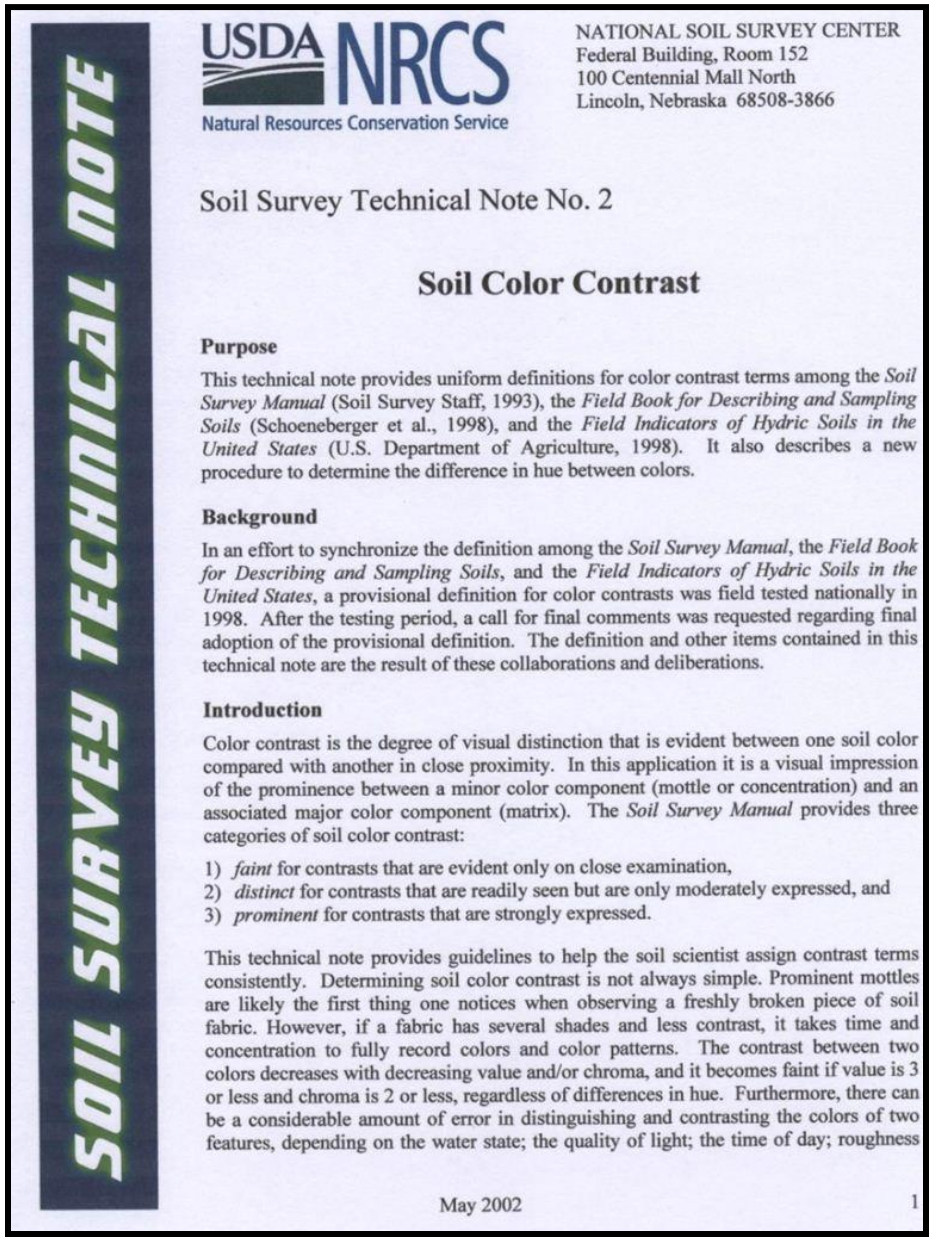
Contrast refers to the degree of visual distinction between associated colors

Faint – contrasts that are evident only on close examination

Distinct -- contrasts that are readily seen but are only moderately expressed

Prominent -- contrasts that are strongly expressed

- Different people cannot uniformly and consistently judge these subjective criteria with no other guidelines
- An objective method is needed to judge the soil color contrast
- Use the USDS NRCS Soil Survey Technical Note No. 2, May 2002 entitled “Soil Color Contrast”



SOIL SURVEY TECHNICAL NOTE

USDA NRCS
Natural Resources Conservation Service

NATIONAL SOIL SURVEY CENTER
Federal Building, Room 152
100 Centennial Mall North
Lincoln, Nebraska 68508-3866

Soil Survey Technical Note No. 2

Soil Color Contrast

Purpose

This technical note provides uniform definitions for color contrast terms among the *Soil Survey Manual* (Soil Survey Staff, 1993), the *Field Book for Describing and Sampling Soils* (Schoeneberger et al., 1998), and the *Field Indicators of Hydric Soils in the United States* (U.S. Department of Agriculture, 1998). It also describes a new procedure to determine the difference in hue between colors.

Background

In an effort to synchronize the definition among the *Soil Survey Manual*, the *Field Book for Describing and Sampling Soils*, and the *Field Indicators of Hydric Soils in the United States*, a provisional definition for color contrasts was field tested nationally in 1998. After the testing period, a call for final comments was requested regarding final adoption of the provisional definition. The definition and other items contained in this technical note are the result of these collaborations and deliberations.

Introduction

Color contrast is the degree of visual distinction that is evident between one soil color compared with another in close proximity. In this application it is a visual impression of the prominence between a minor color component (mottle or concentration) and an associated major color component (matrix). The *Soil Survey Manual* provides three categories of soil color contrast:

1) *faint* for contrasts that are evident only on close examination,
2) *distinct* for contrasts that are readily seen but are only moderately expressed, and
3) *prominent* for contrasts that are strongly expressed.

This technical note provides guidelines to help the soil scientist assign contrast terms consistently. Determining soil color contrast is not always simple. Prominent mottles are likely the first thing one notices when observing a freshly broken piece of soil fabric. However, if a fabric has several shades and less contrast, it takes time and concentration to fully record colors and color patterns. The contrast between two colors decreases with decreasing value and/or chroma, and it becomes faint if value is 3 or less and chroma is 2 or less, regardless of differences in hue. Furthermore, there can be a considerable amount of error in distinguishing and contrasting the colors of two features, depending on the water state; the quality of light; the time of day; roughness

May 2002 1

Cover page

Definitions of soil color contrast terms

Note: If the mottle and matrix both have **values** of ≤ 3 and **chromas** of ≤ 2, the color contrast is ***Faint***, **regardless of the difference in hue**.

Faint - Evident only on close examination. The contrast is faint if the:

1) difference in hue = 0, difference in value is ≤2, and difference in chroma is ≤1, or
2) difference in hue = 1, difference in value is ≤1, and difference in chroma is ≤1, or
3) difference in hue = 2, difference in value = 0, and difference in chroma = 0, or
4) difference in hue is ≥ 3 and both colors have values of ≤3 and chromas of ≤2.

Distinct - Readily seen but contrast only moderately with the color to which compared. The contrast is distinct if the:

1) difference in hue = 0, and
   a. difference in value is ≤2 and difference in chroma is >1 to <4, or
   b. difference in value is >2 to <4 and difference in chroma is <4.
2) difference in hue = 1, and
   a. difference in value is ≤1 and difference in chroma is >1 to <3, or
   b. difference in value is >1 to <3, and difference in chroma is <3.
3) difference in hue = 2, and
   a. difference in value = 0 and difference in chroma is >0 to <2, or
   b. difference in value is >0 to <2 and difference in chroma is <2.

Prominent - Contrasts strongly with the color to which compared. Color contrasts that are not faint or distinct are prominent.

- In the following slides, the symbol “Δ”(delta) means “change or difference in”
- For example: Δh=1 means the change of hue between the two colors is one 2.5-unit interval
- Example 7.5YR to 10YR
  Use the method given in the technical note to determine hue difference (already covered)

IMPORTANT NOTE

- If the mottle and matrix both have values of ≤3 and chromas of ≤2, the color contrast is faint by definition
- <u>This is regardless of the difference in hue</u>

Table 1 - Tabular key for contrast determination using Munsell® notation

Note: If both colors have values of ≤ 3 and chromas of ≤ 2, the color contrast is *Faint* (regardless of the difference in hue).

Hues are the same (Δ h = 0)

Δ Value	Δ Chroma	Contrast
0	≤1	Faint
0	2	Distinct
0	3	Distinct
0	≥4	Prominent
1	≤1	Faint
1	2	Distinct
1	3	Distinct
1	≥4	Prominent
≤2	≤1	Faint
≤2	2	Distinct
≤2	3	Distinct
≤2	≥4	Prominent
3	≤1	Distinct
3	2	Distinct
3	3	Distinct
3	≥4	Prominent
≥4	---	Prominent

Hues differ by 2 (Δ h = 2)

Δ Value	Δ Chroma	Contrast
0	0	Faint
0	1	Distinct
0	≥2	Prominent
1	≤1	Distinct
1	≥2	Prominent
≥2	---	Prominent

Hues differ by 1 (Δ h = 1)

Δ Value	Δ Chroma	Contrast
0	≤1	Faint
0	2	Distinct
0	≥3	Prominent
1	≤1	Faint
1	2	Distinct
1	≥3	Prominent
2	≤1	Distinct
2	2	Distinct
2	≥3	Prominent
≥3	---	Prominent

Hues differ by 3 or more (Δ h ≥ 3)

Δ Value	Δ Chroma	Contrast
Color contrast is prominent, except for low chroma and value.		Prominent

Hues are the same (Δ h = 0)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	3	Distinct
0	≥4	Prominent
1	≤1	Faint
1	2	Distinct
1	3	Distinct
1	≥4	Prominent
≤2	≤1	Faint
≤2	2	Distinct
≤2	3	Distinct
≤2	≥4	Prominent
3	≤1	Distinct
3	2	Distinct
3	3	Distinct
3	≥4	Prominent
≥4	---	Prominent

Δh = 0:

3 Faint

9 Distinct

5 Prominent

(Note that a Δ value or Δ chroma ≥4 is prominent)

Hues differ by 1 (Δ h = 1)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	≥3	Prominent
1	≤1	Faint
1	2	Distinct
1	≥3	Prominent
2	≤1	Distinct
2	2	Distinct
2	≥3	Prominent
≥3	---	Prominent

Δh = 1

2 Faint

4 Distinct

4 Prominent

(Note that a Δ value or Δ chroma ≥3 is prominent

Hues differ by 2 ($\Delta h = 2$)

Δ Value	Δ Chroma	Contrast
0	0	Faint
0	1	Distinct
0	≥2	Prominent
1	≤1	Distinct
1	≥2	Prominent
≥2	---	Prominent

$\Delta h = 2$

1 Faint

2 Distinct

3 Prominent (Note that a Δ value or Δ chroma ≥ 2 is prominent)

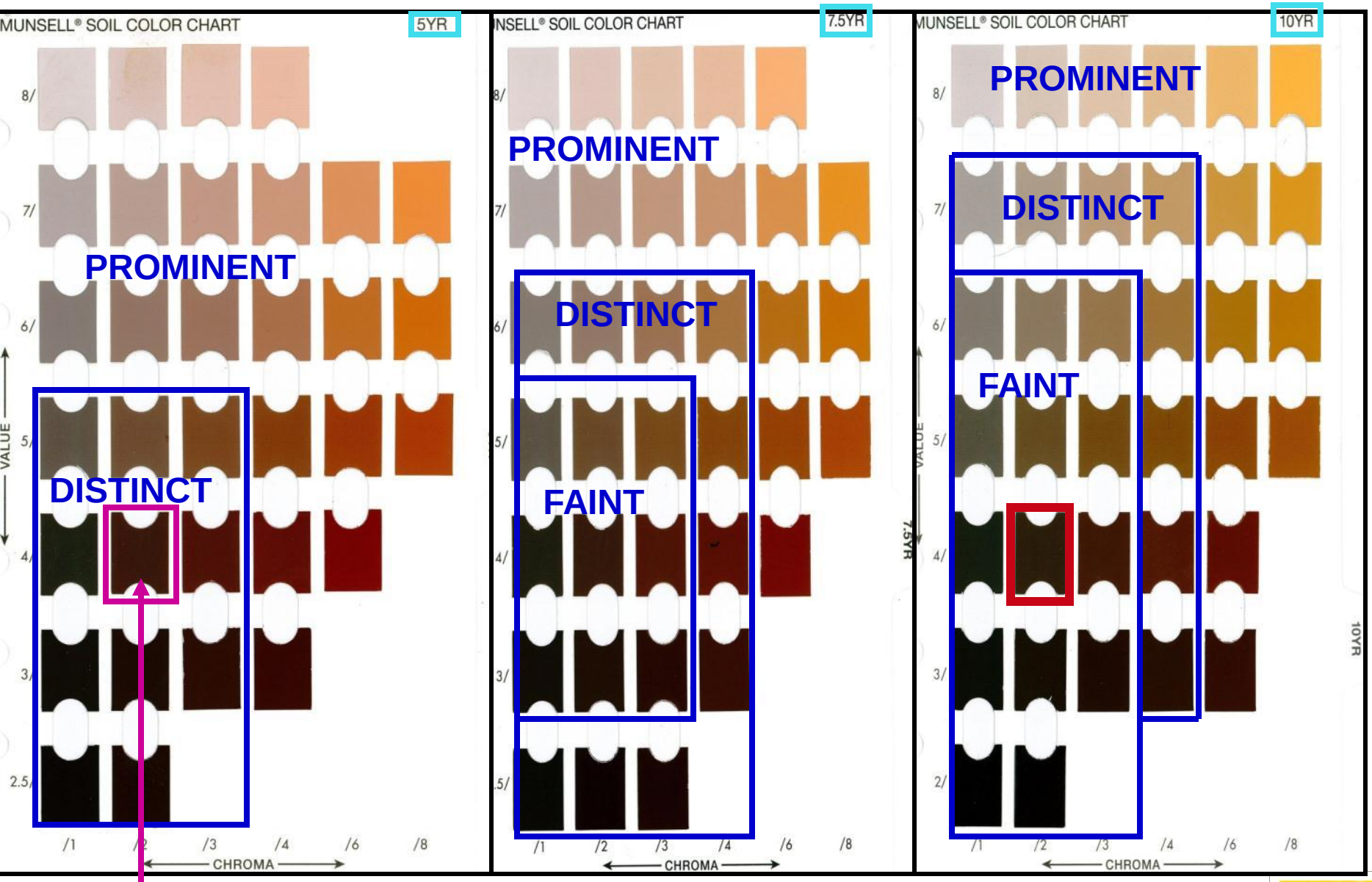
Hues differ by 3 or more ($\Delta h \geq 3$)		
Δ Value	**Δ Chroma**	**Contrast**
Color contrast is prominent, except for low chroma and value.		Prominent

$\Delta h \geq 3$

- All color contrast is prominent by definition
- *Exception*: Colors with values ≤3 and chromas ≤2 are faint by definition, regardless of hue change

Soil Color Contrast Examples

- On the following slide, the matrix Color 10YR 4/2 (red box area) is used for comparison to surrounding colors
- The soil color contrasts are as follows


MUNSELL® SOIL COLOR CHART
5YR
7.5YR
10YR
PROMINENT
DISTINCT
FAINT
VALUE
CHROMA
8/
7/
6/
5/
4/
3/
2.5/
2/
/1
/2
/3
/4
/6
/8

FAINT

If you believe you have found a discrepancy in the chart:

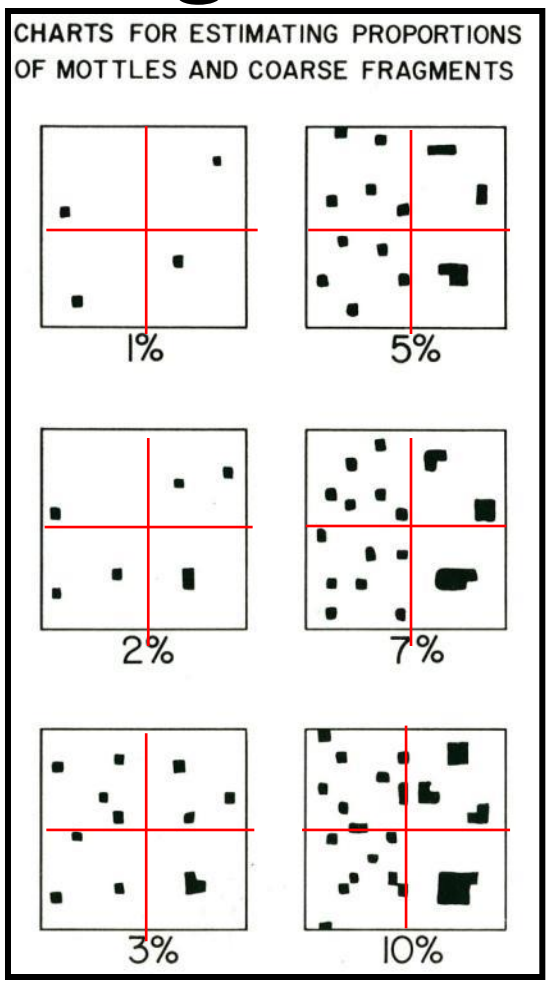
USE “DEFINITION OF SOIL COLOR CONTRAST TERMS”

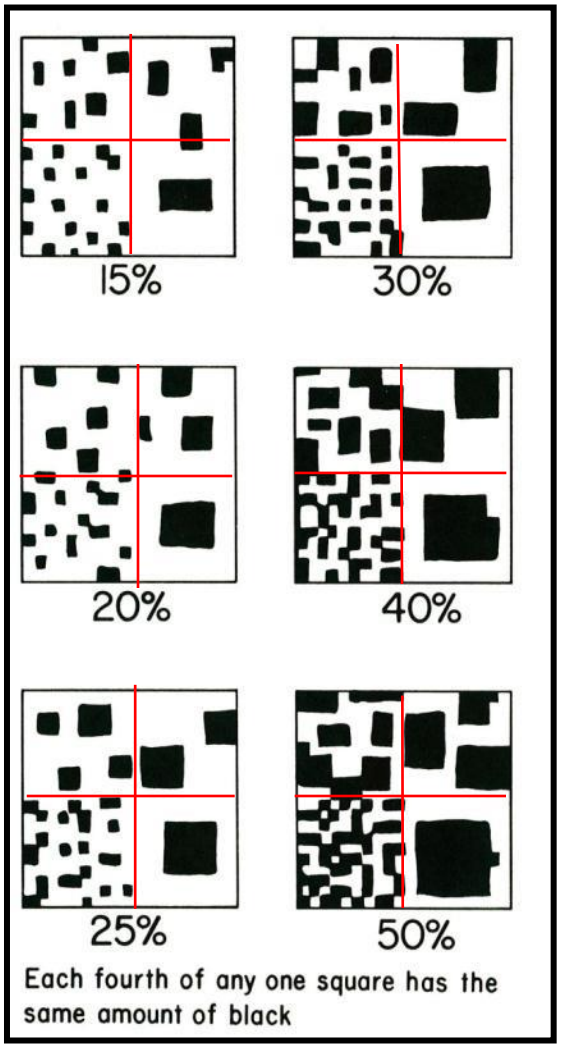
Determining Amount of Mottles

- Use “Charts for Estimating Proportions of Mottles and Coarse Fragments”
- Quantifies the amount of redox features
- Located in Munsell Book

Abundance and Size of Color Contrasting Areas

- **Size of mottles**
  Fine < 5 mm
  Medium 5 to 15 mm
  Coarse > 15 mm
- ***Note that the size of the mottles do not matter, only the amount***

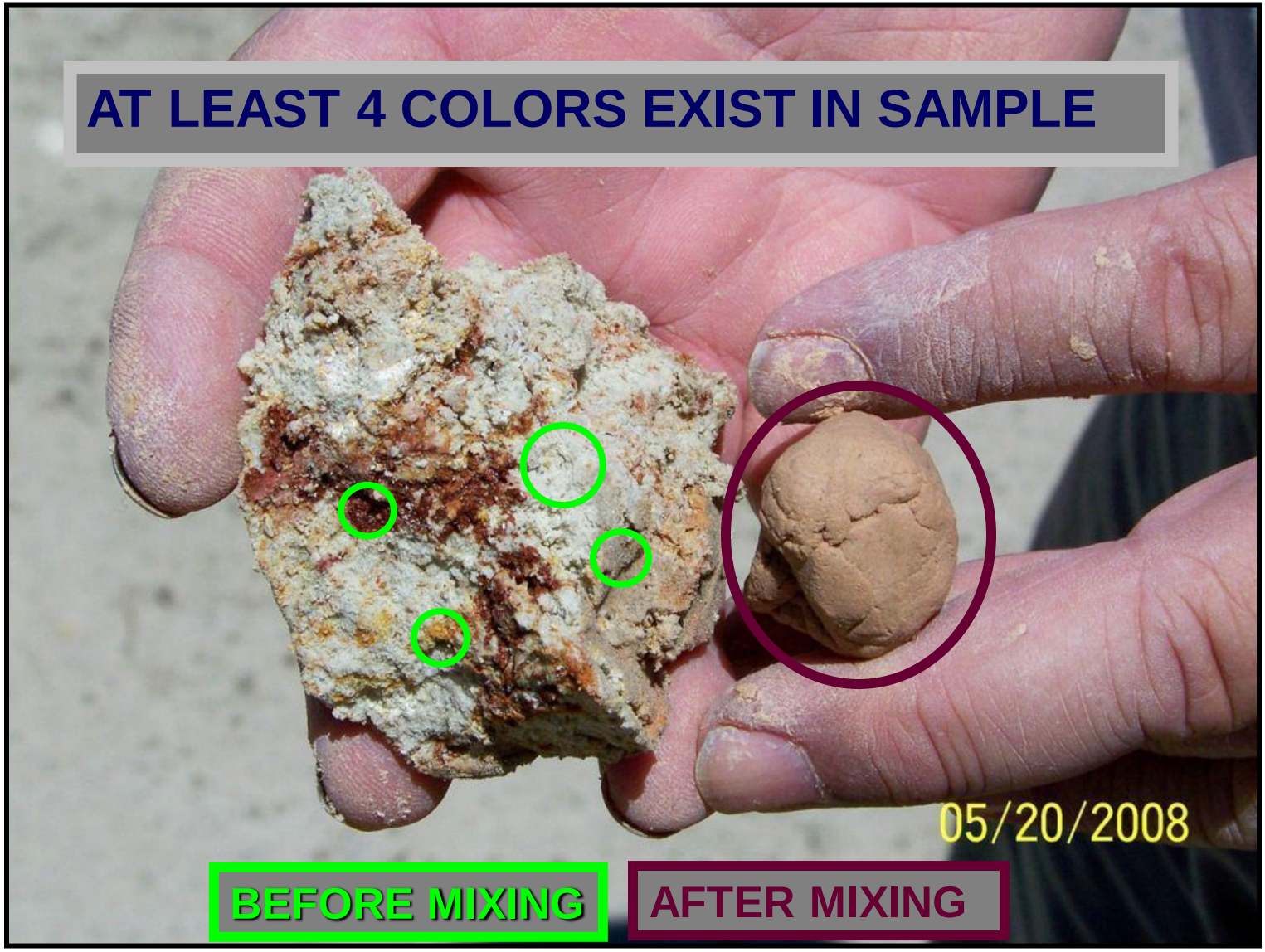




QUESTIONS?

Color or Texture First?

- Color-Redox features could be overlooked due to the physical manipulation of the soil if it was textured first
- All colors in the sample are recorded before texturing
- Multiple colors easily blend
- The same soil sample should be used to color and texture-increases accuracy of the profile


AT LEAST 4 COLORS EXIST IN SAMPLE
05/20/2008
BEFORE MIXING
AFTER MIXING

Soil Sampling

- All samples should come from an area that has not been marred from the action of taking the sample
- Especially true for heavy-textured soils
- Samples come from auger buckets, shovels, backhoe buckets, etc.
- Ensure that sample is natural soil, not adulterated

Sampling heavy-textured soils

- Obtain sample from the area of least disturbance, normally interior of the sample
- The soil sample should be broken longitudinally to observe the colors and to collect the sample for texturing

EXAMPLE IN AUGER BUCKET

Outside of sample-air changed color of sample, now more red

INSIDE THE AUGER BUCKET

Inside of sample-no oxidation-correct color of soil as it appears in profile

Sandy soils

- Samples don’t normally come out in chunks as do finer textured soils
- Must be unadulterated and unmarred (sandy soils can contain other things)
- When sampling any soil, ensure that sample is a natural sample from the intended area

Sandy Soil with Red Mottles

Sample Observations

- Take the time to properly observe soil sample
- Redox features can be missed while using an auger
- Larger sample size increases area for SHWT indicator observation
- Sharpshooter-type shovels should be used closer to ground surface

Approximate comparison between samples found in auger and sharpshooter-type shovel

END OF PRESENTATION

QUESTIONS?