



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-F405

Soil Color Determination (Munsell)

Standard Operating Procedure

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1. Purpose

This SOP describes the field determination of soil color using the Munsell Soil Color Charts. Soil color is one of the most readily observable soil properties and provides information about organic matter content, drainage and aeration status, mineralogy, and degree of weathering (Munsell Color, 2009; Schoeneberger et al., 2012). Lower values (darker soils) generally reflect higher organic matter content, especially in A horizons, while high chroma indicates well-drained, oxidized conditions and low chroma suggests prolonged saturation or reducing environments (Lynn & Pearson, 1993; Shields et al., 1966). Red and yellow hues are controlled primarily by iron oxide mineralogy: hematite produces redder hues (5YR and redder), while goethite produces yellowish-brown hues (7.5YR–10YR) (Schwertmann, 1993; Torrent & Schwertmann, 1983). Consistent color determination is essential for soil profile descriptions ([SOP-F407](#)), wetland delineation, and site characterization.

2. Scope

- **Applies to:** Field determination of soil color for all EA Program soil sampling campaigns, profile descriptions, and site characterizations
- **Does not apply to:** Instrumental color measurement (colorimeters or spectrophotometers); rock or sediment color classification using the Rock Color Chart; Munsell readings on dried, ground samples in the lab (see [SOP-L419](#))
- **Location:** All EA Program field sites; can also be performed on fresh samples in the lab

3. Responsibilities

Role	Responsibility
PI / Field Lead	Ensure Munsell charts are available and in good condition
Trained Personnel	Determine soil color per this SOP
New Students	Complete training and inter-observer calibration exercise

4. Definitions

- **Chroma:** The colorimetric purity or saturation of a color; the third component of Munsell notation (e.g., the 4 in 10YR 4/4); low chroma (2 or less) in subsurface horizons indicates gleying and periodic waterlogging.
- **Gleying:** A reduction process in waterlogged soils that depletes iron and produces low-chroma (gray, blue-gray, or green-gray) matrix colors; a diagnostic indicator of hydric soil conditions.
- **Hue:** The dominant spectral color in Munsell notation (e.g., 10YR, 7.5YR, 2.5Y, Gley 1); the first element of a Munsell designation; corresponds to the dominant wavelength of reflected light.
- **Matrix color:** The dominant color occupying more than 50% of the exposed soil face; recorded first in the Munsell notation before mottles or redoximorphic features.
- **Mottle:** A spot or blotch of color contrasting with the matrix color; described by abundance (few, common, many), size (fine, medium, coarse), and contrast (faint, distinct, prominent).
- **Munsell color system:** A standardized three-dimensional color notation (Hue Value/Chroma) used universally in soil science for objective color description; readings must be made in consistent natural or reference lighting conditions.
- **Redoximorphic features:** Color patterns caused by reduction and oxidation of iron and manganese under fluctuating saturation; include masses (concentrations of iron oxides) and depletions (zones of low chroma); diagnostic for hydric soil identification and wetland delineation.
- **Value:** The lightness or darkness of a color in Munsell notation; ranges from 0 (black) to 10 (white); the second component of Munsell notation (e.g., the 4 in 10YR 4/4).

5. Safety and Hazards

Hazards

- **Biological:** Soil-borne pathogens; wash hands after handling soil.
- **Physical:** Standard field hazards (ticks, snakes, heat exposure).
- **Chemical:** At contaminated sites, soil may contain heavy metals or other hazardous materials; wear gloves.

5.1. Required PPE

- ☐ Closed-toed shoes or field boots
- ☐ Nitrile gloves (recommended)
- ☐ Sun protection (hat, sunscreen)

5.2. Emergency Procedures

Refer to [SOP-F001 Field Safety](#).

6. Equipment and Materials

Item	Notes
Munsell Soil Color Charts (current edition)	Handle with clean, dry hands; protect from rain and direct soil contact
Trowel or soil knife	For exposing fresh soil surfaces
Squeeze bottle with DI water	For moistening dry samples
Paper towels	For cleaning hands between samples
Field notebook	For recording colors

7. Background: The Munsell System

Munsell color notation has three components (Munsell Color, 2009; Soil Survey Staff, 2022):

- **Hue:** The dominant spectral color (e.g., 10YR, 2.5Y, 5YR). Pages in the chart book are arranged by hue.
- **Value:** Lightness, from 0 (absolute black) to 10 (absolute white). Vertical axis on each page.
- **Chroma:** Color intensity or saturation, from 0 (neutral gray) outward. Horizontal axis on each page.

A complete Munsell notation is written as: **Hue Value/Chroma** (e.g., 10YR 4/3). The corresponding color name (e.g., “brown” or “dark yellowish brown”) is listed on each chip.

8. Procedure

8.1. Sample Preparation

1. Expose a fresh soil surface by breaking a ped or cutting with a trowel. Do not use smeared or scraped surfaces, as smearing compresses the soil and alters the apparent color.
2. Determine color on **moist** soil. If the soil is dry, add a few drops of DI water to a small subsample and allow it to absorb for 30 seconds before reading.
3. If both moist and dry colors are needed (e.g., for profile descriptions), read the moist color first, then allow a portion to air-dry and read the dry color.

8.2. Reading the Color

1. Work in natural daylight, ideally under an overcast sky or in open shade. Avoid direct sunlight on the soil or the chart, as glare distorts color perception. Do not read colors under artificial light or at twilight.
2. Hold the soil sample behind the chart page apertures so that the soil is visible through the holes.
3. Compare the soil to the color chips (Schoeneberger et al., 2012). Start with the hue page that appears closest, then move to the value row that matches, then slide along the chroma axis.
4. Select the chip that most closely matches the soil. If the soil falls between two chips, record the notation of the nearest chip and note “between X and Y” in the field notebook.
5. Record the full Munsell notation and the color name:
 - Example: **10YR 3/2 (very dark grayish brown)**
6. If the soil contains mottles or redoximorphic features, record the matrix color and then the mottle color(s) separately, noting the abundance (few, common, many), size (fine, medium, coarse), and contrast (faint, distinct, prominent).

8.3. Special Cases

Organic soils (O horizons, peat): Use the Gley pages or the 10YR page with very low value and chroma. Very dark colors (value 2 or less) are common.

Gleyed soils: Use the Gley 1 and Gley 2 pages for soils with chroma of 2 or less and hues bluer than 5Y. Gleyed colors indicate prolonged saturation and reducing conditions.

Mottled soils: Record:

- Matrix color (dominant color occupying more than 50% of the surface)
- Mottle colors (each distinct color)
- For each mottle: abundance, size, and contrast

Abundance	Definition
Few	< 2% of exposed surface
Common	2–20% of exposed surface

Abundance	Definition
Many	> 20% of exposed surface

Size	Definition
Fine	< 5 mm diameter
Medium	5–15 mm diameter
Coarse	> 15 mm diameter

Contrast	Definition
Faint	Hue, value, and chroma differ by 1 unit or less from matrix
Distinct	Differ by 2–3 units in value or chroma
Prominent	Differ by more than 3 units

Redoximorphic features are diagnostic for hydric soil identification and wetland delineation; consistent recording of mottle properties is critical for regulatory applications (Soil Survey Division Staff, 2017).

9. Quality Control

- At the start of each field season, have two or more observers independently read the same soil samples to assess inter-observer agreement. Readings should agree within one chip (one unit of value or chroma) in at least 80% of comparisons.
- Replace Munsell charts when color chips are faded, soiled, or damaged. Faded chips produce systematic errors.
- Record lighting conditions (overcast, open shade, sunny) in the field notebook; lighting affects color perception.
- Always specify whether the reading was on moist or dry soil.

Digital colorimeters and smartphone-based color apps are increasingly used as supplements to visual Munsell matching; however, instrument readings and visual assessments can disagree, especially at low chroma and low value, so visual Munsell determination remains the standard for USDA soil survey and regulatory work (Viscarra Rossel et al., 2006).

10. References

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11. Related SOPs

SOP	Title	Relationship
F001	Field Safety	Required prerequisite
F400	Soil Sampling	Soil collection for color reading
F407	Soil Profile Description	Color is part of profile description
L419	Soil Color (Munsell – Lab)	Lab confirmation of field color

12. Training Record

Before determining soil color independently, personnel must:

1. Read this SOP in full
2. Complete an inter-observer calibration exercise with a trained operator, achieving agreement within one chip on at least 8 of 10 test samples
3. Be signed off by the PI or field lead