## Soil Color

Elements of soil color descriptions are the color name, the Munsell notation, the water state, and the physical state: "brown (10YR 5/3), dry, crushed, and smoothed."

Physical state is recorded as broken, rubbed, crushed, or crushed and smoothed. The term "crushed" usually applies to dry samples and "rubbed" to moist samples. If unspecified, the surface is broken. The color of the soil is recorded for a surface broken through a ped if a ped can be broken as a unit.

The color value of most soil material becomes lower after moistening. Consequently, the water state of a sample is always given. The water state is either "moist" or "dry." The dry state for color determinations is air-dry and should be made at the point where the color does not change with additional drying. Color in the moist state is determined on moderately moist or very moist soil material and should be made at the point where the color does not change with

additional moistening. The soil should not be moistened to the extent that glistening takes place as color determinations of wet soil may be in error because of the light reflection of water films. In a humid region, the moist state generally is considered standard; in an arid region, the dry state is standard. In detailed descriptions, colors of both dry and moist soil are recorded if feasible. The color for the regionally standard moisture state is usually described first. Both moist and dry colors are particularly valuable for the immediate surface and tilled horizons in order to assess reflectance.

*Munsell notation* is obtained by comparison with a Munsell system color chart. The most commonly used chart includes only about one fifth of the entire range of hues.[1] It consists of about 250 different colored papers, or chips, systematically arranged on hue cards according to their Munsell notations. Figure 3-24 illustrates the arrangements of color chips on a Munsell color card.

The Munsell color system uses three elements of color—*hue, value,* and *chroma*—to make up a color notation. The notation is recorded in the form: hue, value/chroma—for example, 5Y 6/3.

*Hue* is a measure of the chromatic composition of light that reaches the eye. The Munsell system is based on five principal hues: red (R), yellow (Y), green (G), blue (B), and purple (P). Five intermediate hues representing midpoints between each pair of principal hues complete the 10 major hue names used to describe the notation. The intermediate hues are yellow-red (YR), green-yellow (GY), blue-green (BG), purple-blue (PB), and red-purple (RP). The relationships among the 10 hues are shown in figure 3-25. Each of the 10 major hues is divided into four segments of equal visual steps, which are designated by numerical values applied as prefixes to the symbol for the hue name.[2] In figure 3-25, for example, 10R marks a limit of red hue. Four equally spaced steps of the adjacent yellow-red (YR) hue are identified as 2.5YR, 5YR, 7.5YR, and 10YR respectively. The standard chart for soil has separate hue cards from 10R through 5Y.

*Value* indicates the degree of lightness or darkness of a color in relation to a neutral gray scale. On a neutral gray (achromatic) scale, value extends from pure black (0/) to pure white (10/). The value notation is a measure of the amount of light that reaches the eye under standard lighting conditions. Gray is perceived as about halfway between black and white and has a value notation of 5/. The actual amount of light that reaches the eye is related logarithmically to color value. Lighter colors are indicated by numbers between 5/ and 10/; darker colors are indicated by numbers from 5/ to 0/. These values may be designated for either achromatic or chromatic conditions. Thus, a card of the color chart for soil has a series of chips arranged vertically to show equal steps from the lightest to the darkest shades of that hue. Figure 3-24 shows this arrangement vertically on the card for the hue of 10YR.

*Chroma* is the relative purity or strength of the spectral color. Chroma indicates the degree of saturation of neutral gray by the spectral color. The scales of chroma for soils extend from /0 for neutral colors to a chroma of /8 as the strongest expression of color used for soils. Figure 3-24 illustrates that color chips are arranged horizontally by increasing chroma from left to right on the color card.

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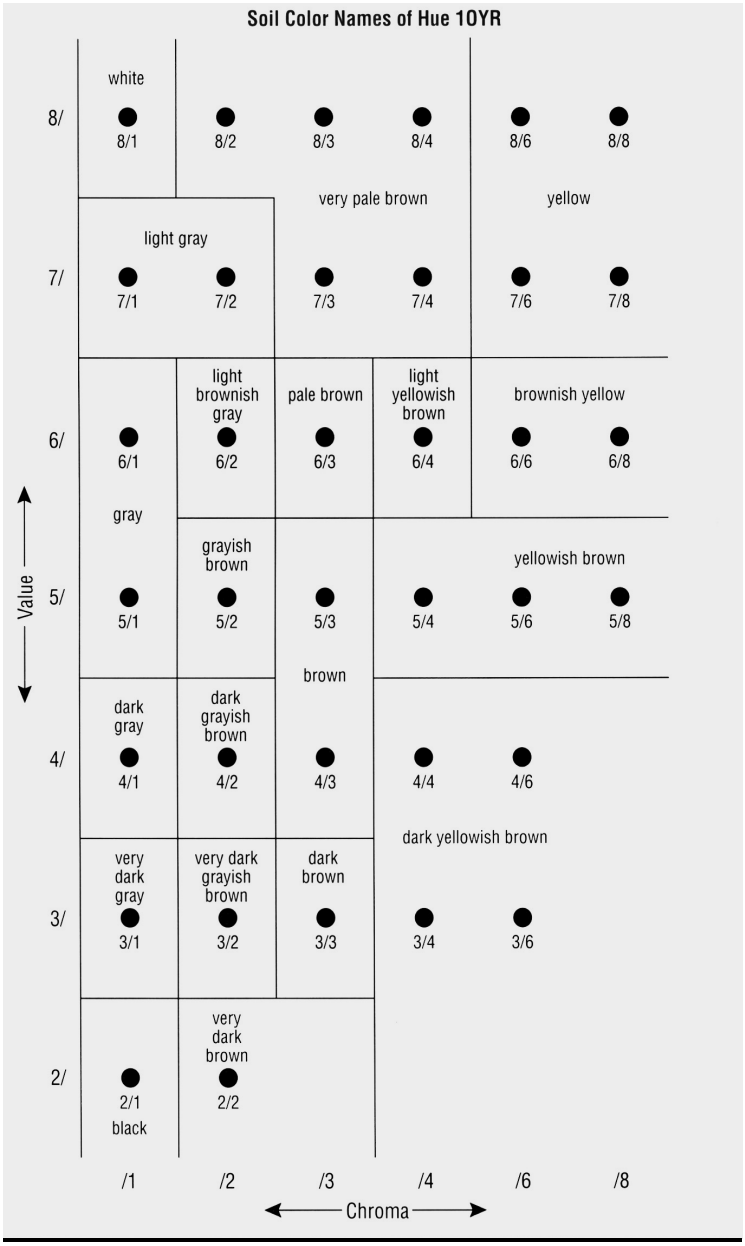
[1] The appropriate color chips, separate or mounted by hue on special cards for a loose leaf notebook, may be obtained from the Munsell Company.

[2] The notation for hue, and for value and chroma, is decimal and could be refined to any degree. In practice, however, only the divisions on the color charts are used.

**FIGURE 3-24**



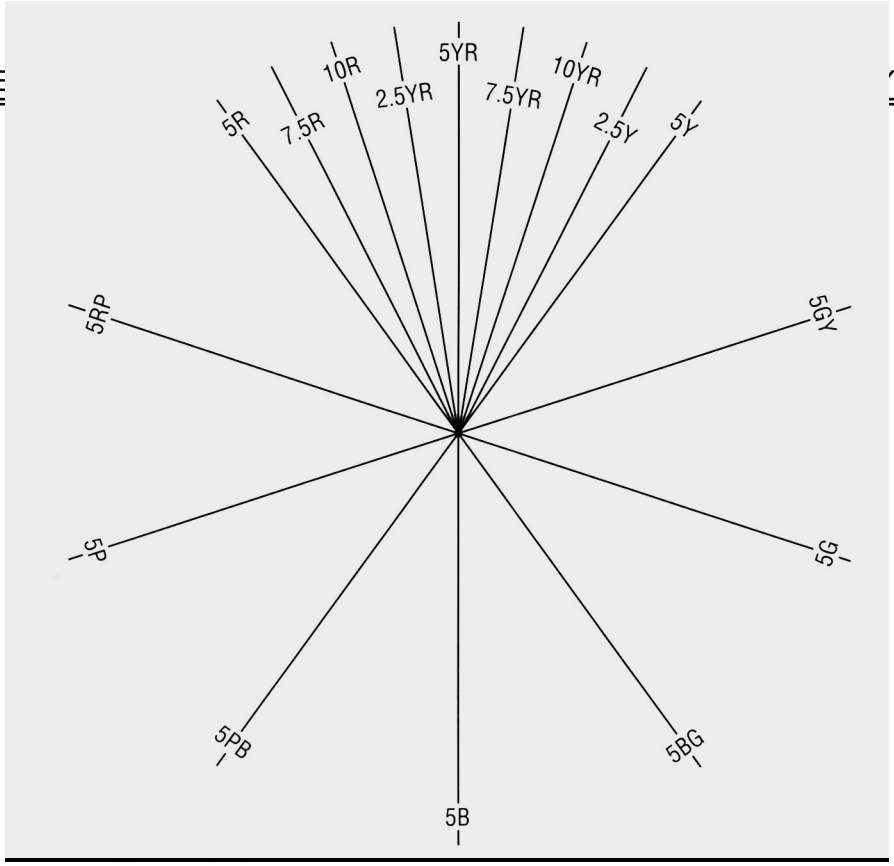

The arrangement of color chips according to value and chroma on the soil-color card of 10YR hue.

The complete color notation can be visualized from figure 3-24. Pale brown, for example, is designated 10YR 6/3. Very dark brown is designated 10YR 2/2. All of the colors on the chart have hue of 10YR. The darkest shades of that hue are at the bottom of the card and the lightest shades are at the top. The weakest expression of chroma (the grayest color) is at the left; the strongest expression of chroma is at the right.

At the extreme left of the card are symbols such as N 6/. These are colors of zero chroma which are totally achromatic—neutral color. They have no hue and no chroma but range in value

from black (N 2/) to white (N 8/). An example of a notation for a neutral (achromatic) color is N 5/ (gray). The color 10YR 5/1 is also called "gray," for the hue is hardly perceptible at such low chroma.

**Conditions for measuring color.—**The quality and intensity of the light affect the amount and quality of the light reflected from the sample to the eye. The moisture content of the sample and the roughness of its surface affect the light reflected. The visual impression of color from the standard color chips is accurate only under standard conditions of light intensity and quality. Color determination may be inaccurate early in the morning or late in the evening. When the sun is low in the sky or the atmosphere is smoky, the light reaching the sample and the light reflected is redder. Even though the same kind of light reaches the color standard and the sample, the reading of sample color at these times is commonly one or more intervals of hue redder than at midday. Colors also appear different in the subdued light of a cloudy day than in bright sunlight. If artificial light is used, as for color determinations in an office, the light source used must be as near the white light of midday as possible. With practice, compensation can be made for the differences unless the light is so subdued that the distinctions between color chips are not apparent. The intensity of incidental light is especially critical when matching soil to chips of low chroma and low value.




A schematic diagram of relationships among the five principal and five intermediate hues of the Munsell Color System and subdivisions within the part used for most soil colors.

*Roughness* of the reflecting surface affects the amount of reflected light, especially if the incidental light falls at an acute angle. The incidental light should be as nearly as possible at a right angle. For crushed samples, the surface is smoothed; the state is recorded as "dry, crushed, and smoothed."

## Recording Guidelines

**Uncertainty.—**Under field conditions, measurements of color are reproducible by different individuals within 2.5 units of hue (one card) and 1 unit of value and chroma. Notations are made to the nearest whole unit of value and chroma.

Before 1989, the cards for hues of 2.5YR, 7.5YR, and 2.5Y did not include chips for colors having chroma of 3. These colors are encountered frequently in some soils and can be estimated reliably by interpolation between adjacent chips of the same hue. Chips for chromas of 5 and 7 are not provided on any of the standard color cards. Determinations are usually not precise enough to justify interpolation between chromas of 4 and 6 or 6 and 8. Color should never be extrapolated beyond the highest chip. It should also be rounded to the nearest chip.

For many purposes, the differences between colors of some adjacent color chips have little significance. For such purposes, color notations have been grouped, and the groups have been named (fig. 3-24).

## Dominant Color

The dominant color is the color that occupies the greatest volume of the layer. Dominant color (or colors) is always given first among those of a multicolored layer. It is judged on the basis of

colors of a broken sample. For only two colors, the dominant color makes up more than 50 percent of the volume. For three or more colors, the dominant color makes up more of the volume of the layer than any other color, although it may occupy less than 50 percent. The expression "brown with yellowish brown and grayish brown" signifies that brown is the dominant color. It may or may not make up more than 50 percent of the layer.

In some layers, no single color is dominant and the first color listed is not more prevalent than others. The expression "brown and yellowish brown with grayish brown" indicates that brown and yellowish brown are about equal and are codominant. If the colors are described as "brown, yellowish brown, and grayish brown," the three colors make up nearly equal parts of the layer.

## Mottling

*Mottling* refers to repetitive color changes that cannot be associated with compositional properties of the soil. Redoximorphic features are a type of mottling that is associated with wetness. A color pattern that can be related to proximity to a ped surface or other organizational or compositional feature is not mottling. Mottle description follows the dominant color. Mottles are described by quantity, size, contrast, color, and other attributes in that order.

*Quantity* is indicated by three areal percentage classes of the observed surface:

*few:* less than 2 percent,

*common:* 2 to 20 percent, and

*many:* more than 20 percent.

The notations must clearly indicate to which colors the terms for quantity apply. For example, "common grayish brown and yellowish brown mottles" could mean that each makes up 2 to 20 percent of the horizon. By convention, the example is interpreted to mean that the quantity of the two colors *together* is between 2 and 20 percent. If each color makes up between 2 and 20 percent, the description should read "common grayish brown (10YR 5/2) and common yellowish brown (10YR 5/4) mottles."

*Size* refers to dimensions as seen on a plane surface. If the length of a mottle is not more than two or three times the width, the dimension recorded is the greater of the two. If the mottle is long and narrow, as a band of color at the periphery of a ped, the dimension recorded is the smaller of the two and the shape and location are also described. Three size classes are used:

*fine:* smaller than 5 mm,

*medium:* 5 to 15 mm, and

*coarse:* larger than 15 mm.

*Contrast* refers to the degree of visual distinction that is evident between associated colors:

*Faint:* Evident only on close examination. Faint mottles commonly have the same hue as the color to which they are compared and differ by no more than 1 unit of chroma or 2 units of

value. Some faint mottles of similar but low chroma and value differ by 2.5 units (one card) of hue.

*Distinct:* Readily seen but contrast only moderately with the color to which they are compared. Distinct mottles commonly have the same hue as the color to which they are compared but differ by 2 to 4 units of chroma or 3 to 4 units of value; or differ from the color to which they are compared by 2.5 units (one card) of hue but by no more than 1 unit of chroma or 2 units of value.

*Prominent:* Contrast strongly with the color to which they are compared. Prominent mottles are commonly the most obvious color feature of the section described. Prominent mottles that have medium chroma and value commonly differ from the color to which they are compared by at least 5 units (two pages) of hue if chroma and value are the same; at least 4 units of value or chroma if the hue is the same; or at least 1 unit of chroma or 2 units of value if hue differs by 2.5 units (one card).

Contrast is often not a simple comparison of one color with another but is a visual impression of the prominence of one color against a background commonly involving several colors.

Shape, location, and character of boundaries of mottles are indicated as needed. *Shape* is described by common words such as streaks, bands, tongues, tubes, and spots. *Location* of mottles as related to structure of the soil may be significant. *Boundaries* may be described as *sharp* (color gradation is not discernable with the naked eye), *clear* (color grades over less than 2 mm), or *diffuse* (color grades over more than 2 mm).

Moisture state and physical state of the dominant color are presumed to apply to the mottles unless the description states otherwise. An example, for which a standard moist broken state of the sample has been specified, might read "brown (10YR 4/3), brown (10YR 5/3) dry; many medium distinct yellowish brown (10YR 5/6) mottles, brownish yellow (10YR 6/6) dry." Alternatively, the colors in the standard moisture state may be given together, followed by the colors at other moisture states. The color of mottles commonly is given only for the standard state unless special significance can be attached to colors at another state.

A nearly equal mixture of two colors for a moist broken standard state can be written "intermingled brown (10YR 4/3) and yellowish brown (10YR 5/6) in a medium distinct pattern; brown (10YR 5/3) and brownish yellow (10YR 6/6) dry." If a third color is present, "common medium faint dark grayish brown (10YR 4/2) mottles, grayish brown (10YR 5/2) dry" can be added.

If the mottles are fine and faint so that they cannot be compared easily with the color standards, the Munsell notation should be omitted. Other abbreviated descriptions are used for specific circumstances.

### Color Patterns

Color, including mottling, may be described separately for any feature that may merit a separate description, such as peds, concretions, nodules, cemented bodies, filled animal burrows, and the like. Color patterns that exhibit a spatial relationship to composition changes or to features such as nodules or surfaces of structural units may be useful to record because of the inferences that may be drawn about genesis and soil behavior. Colors may be given for extensions of material from another soil layer. The fine tubular color patterns that extend vertically below the A horizon

of some wet soils, for example, were determined by the environment adjacent to roots that once occupied the tubules. The rim of bright color within an outer layer of lighter color at the surface of some peds relate to water movement into and out of the peds and to oxidation-reduction relationships.

**Ground surface color.—**The color value of the immediate ground surface may differ markedly from that of the surface horizon. For example, raindrop impact may have removed clay-size material from the surface of sand and silt which results in a surficial millimeter or so of increased color value. In some arid soils, dark rock fragments may have reduced the color value of the ground surface appreciably from that of the fine earth of the surface horizon as a whole. Furthermore, dead vegetation may have color values that differ appreciably from those for the fine earth of the surface horizon. Color information is, therefore, desirable for the actual ground surface inclusive of the vegetation as well as the soil material. Surface color influences reflectivity of light, therefore, the capacity to absorb and release radiant energy.

Surface soil colors commonly range widely at a site, and it may be necessary to array mentally the color values and their areal proportion for the ground surface, whether rock fragments, dead vegetation, or fine earth. Then a single color value is selected for each important ground surface component. From the areal proportion of the components, and their color value, a weighted average color value for the ground surface may be computed. Estimation of the areal proportion of components is discussed in the section on ground cover.