Color Differences in Huma Gro® Liquid Products

White Paper

As indicated by the samples of various Huma Gro® liquid products in Fig. 1, colors vary among products. In some instances, fine particles suspended in a product may, through the normal process of settling, create a liquid product with two colors, one light (the liquid phase) and one dark (a suspended phase of very small particles that, individually, are impossible for the human eye to discern.

Figure 1. *Samples of Huma Gro® products*

Differences in colors of different Huma Gro® products may be due to mineral ingredients, as described in Table 1.

Table 1. *Colors of metallic essential plant nutrients in aqueous solution*

Source: Wikipedia

NAME	FORMULA	COLOR
Potassium	$K+$	None
Calcium	$Ca2+$	None
Magnesium	$Mg2+$	None
Manganese(II)	Mn^{2+}	Colorless
Manganate(VII) (Permanganate)	MnO_4^-	Deep Violet
Manganate(VI)	MnO_4^{2-}	Dark Green
Manganate(V)	MnO_4^{3-}	Deep Blue
Iron(II)	Fe^{2+}	Light Blue
Iron(III)	Fe^{3+}	Yellow/Brown
Cobalt(II)	Co^{2+}	Pink
Cobalt-ammonium complex	$Co(NH_3)_6^{3+}$	Yellow/Orange
Nickel(II)	Ni^{2+}	Light Green
Nickel-ammonium complex	$Ni(NH_3)_6^{2+}$	Lavendar/Blue
Copper(II)	Cu^{2+}	Blue
Copper-ammonium complex	$Cu(NH_3)_4^{2+}$	Royal Blue
Tetrachloro-copper complex	$CuCl_4^{2-}$	Yellow/Green
Zinc(II)	Zn^{2+}	Bluish-White

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Huma Gro® products containing potassium (K), calcium (Ca), or magnesium (Mg) have little or no color as a consequence of containing those particular elements, but because the products are produced using Micro Carbon Technology®, organic matter in the products may impart color to them. Salts of magnesium, such as magnesium sulfate (Fig. 2), magnesium nitrate (Fig. 3), and magnesium phosphate (Fig. 4) are white, reflecting the full spectrum of light.

Figure 2. *Magnesium sulfate*

Figure 3. *Magnesium nitrate*

Figure 4. *Magnesium phosphate*

As indicated in Table 1, Huma Gro® products containing copper may appear blue or green, because copper salts such as copper sulfate (Fig. 5), copper nitrate (Fig. 6), and copper chloride (Fig. 7) are blue or blue-green.

Figure 5. *Copper sulfate*

Figure 6. *Copper nitrate*

Figure 7. *Copper chloride*

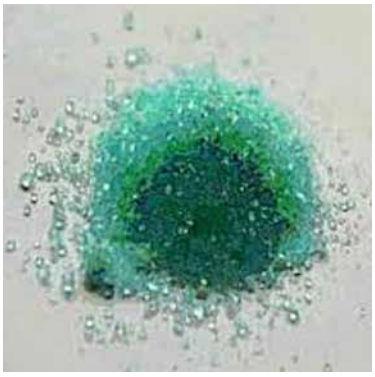

Figure 8. *Iron sulfate*

Figure 9. *Iron oxide*

Figure 10. *Iron humate*

Iron compounds may impart various colors to Huma Gro® products. For example, iron sulfate is green (Fig. 8), iron oxide is red (Fig. 9), and iron humate is brown (Fig. 10).

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Organic Components of Huma Gro Products

Some colors of Huma Gro® products are a result of light interacting with organic matter. Micro Carbon Technology®, which includes organic substances, is an essential ingredient of all Huma Gro® products.
Humic substances, which are pigmented, include organic polymers such as fulvic acid, humic acid, and humin. In addition to essential mineral nutrients, some Huma Gro® products contain mixtures of humic acid, fulvic acid, and small, organic molecules. Colors associated with Micro Carbon Technology,® which includes organic matter, in Huma Gro® products tend to be associated with fulvic acid and with individual molecules that are of lower molecular weight than fulvic acid. The chemical properties of humic substances described by Stevenson (Fig. 11) are useful to help understand relationships between the colors of Huma Gro® products and other chemical properties of Micro Carbon Technology®.

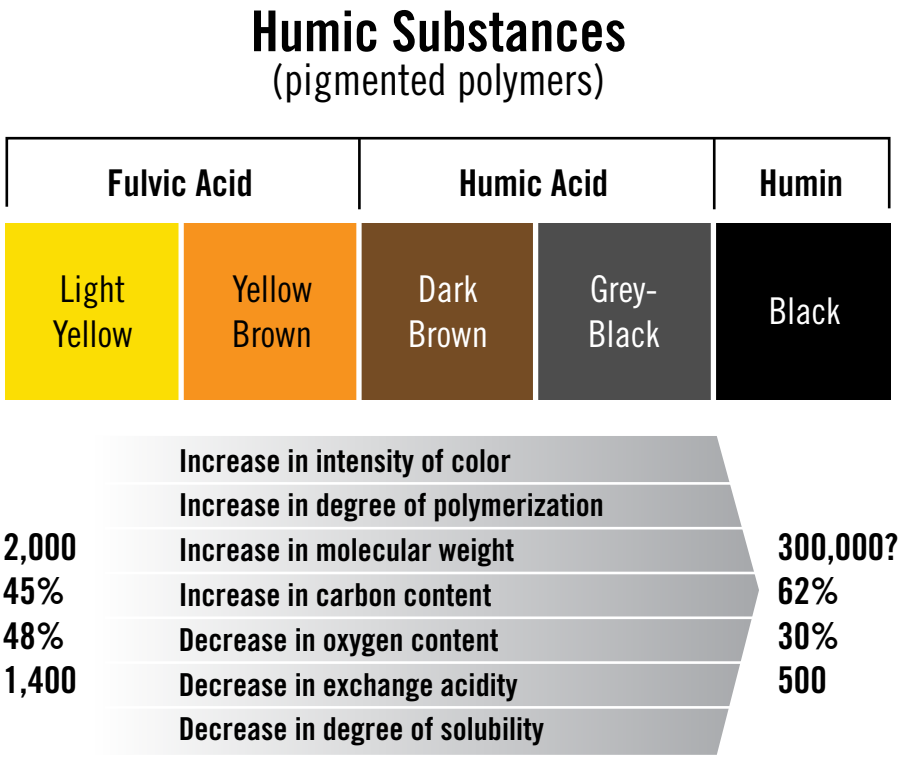

Figure 11. *Colors of Humic substances*

Some Huma Gro® products can change color with the passage of time. Some products have particles called "colloidal" that are less than a millionth of a meter in their longest dimension. Singly, these particles are not visible to the unaided human eye and, under some conditions, these extremely small particles can be attracted to each other in a solution and form a cloudy suspension of aggregated microscopic particles. An example of this phenomenon, which should not affect the quality of the product, is an occurrence of a cloudy suspension formed by the spontaneous aggregation of invisible, microscopic particles that are probably of organic matter. The product, when the microscopic particles of organic matter have not aggregated, is amber in color (Fig. 12). Once some of the microscopic particles are attracted to each other, they form microscopic aggregates that impart a lighter color to the product (Fig. 13).

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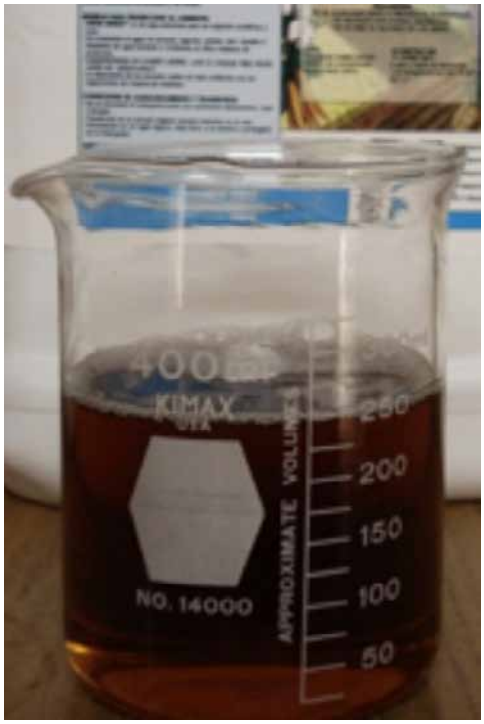

Figure 12. *Amber color*

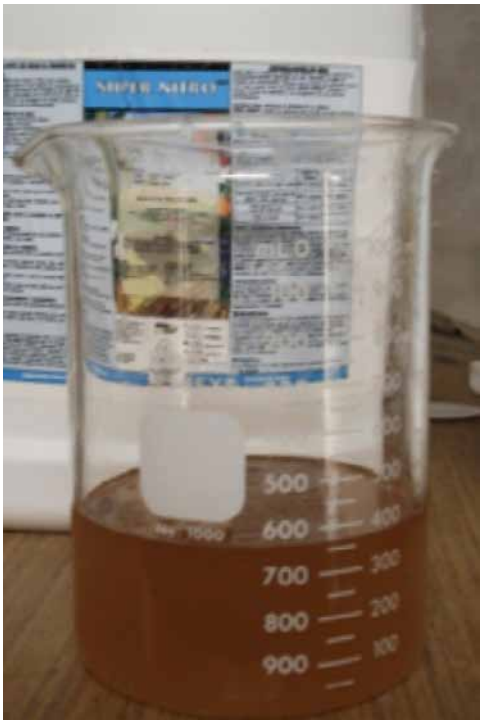

Figure 13. *Suspension*

Occasionally, a cloudy suspension will occur in a liquid fertilizer product, due to a drop in ambient temperature. Huma Gro® products, while formulated over many years to be as concentrated as possible and useful in a wide range of climatic conditions without having problems of turbidity or precipitation, may rarely have incidences of either cloudiness—indicating a suspension of microscopic particles, or precipitation—indicating a stronger aggregation of components of the product. Sometimes such problems are associated with ambient temperature differences, since solubility of substances in water is temperature dependent. In other instances, the acidity or lack thereof of water in which Huma Gro® products are dissolved can affect the solubility of a product.

Conjugated chemical systems such as those produced by Micro Carbon Technology® have properties that can result in strong colors. With additional double bonds, the organic system (e.g., humic acid, fulvic acid, or smaller organic entities with alternating double bonds) absorbs photons of longer wavelengths and lower energy, resulting in colors within the range of yellow to red.

Carbon

The Micro Carbon Technology® of Huma Gro® includes ligands that complex with various metals. These chromophores contribute to the colors of Huma Gro® products. Sometimes the color of a Huma Gro® product will change with the passage of time. In some cases, oxidation-reduction reactions occur that change chromophores, modifying the visible color of the product. Oxidation-reduction processes are ubiquitous in nature, and because of the natural and organic ingredients in Huma Gro® products, occasional changes in color are not surprising.

Huma Gro® welcomes information regarding unexpected cloudiness or precipitation, and will use that information to determine the cause of the problem and correct it. Report any problems to http://humagro.com/contact/.

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Appendix A: Standard Colors of Huma Gro® Products

Huma Gro® Product	Standard Color
2-16-16™	Light amber
38 Special®	Clear to slightly hazy, green
44 Mag®	Clear, light green
Activol®	Clear to slightly hazy, light green
Best-Bale®	Clear to slightly hazy, brown
Boro-Max®	Clear amber
Breakfree™	Dark Brown
Breakout®	Hazy brown
Buffer K™	Yellow
C-Phos™	Clear to slightly hazy, greenish gold
Calcium	Clear to slightly hazy, light amber
Cobalt	Clear, deep reddish purple
Comol™	Clear to slightly hazy, reddish purple
Copper	Clear blue
Crop-Gard®	Clear to hazy, bluish green
D-Fend®	Clear to slightly hazy, light green
Encapsalt®	Hazy, light brown
Fertil Humus®	Clear, brownish purple
Fulvi Pro®	Clear to slightly hazy, amber
Golden Gro™	Clear to slightly hazy, greenish gold
Huma Burst®	Dark brown, black solid material (not liquid)
Huma Pro®	Dark black, brown
Iron	Clear to slightly hazy, light green
Jackpot® (Yield-Max™)	Clear to hazy, dark purplish brown
Kleenup™	Clear to hazy, brownish
Lucky 7®	Clear to slightly hazy, purple
Manganese	Clear, very light yellow
Max Pak®	Clear to slightly hazy, bluish
Mocob™	Dark Red
Molybdenum	Clear to hazy, light tan
Nickel	Clear to slightly hazy, dark bluish
NZ-Phos™	Teal
Promax®	Hazy to opaque, brownish
Proud 3®	Hazy to opaque, brownish
Sil-K™	Clear to slightly hazy amber
Sili-Max®	Slightly hazy amber
Soil-Max™	Hazy, light brown
Start-L™	Clear to hazy, brown
Sulfur	Clear to slightly hazy, light tan
Super K™	Clear, amber
Super Nitro®	Clear to slightly hazy, light brown
Super Phos®	Clear, light greenish amber
Surf-Max®	Hazy, light brown
Vitol®	Hazy, greenish brown
Vitol® II	Hazy, greenish
X-Tend®	Hazy brown
X-Tend® B	Clear to hazy, blue
Z-Max®	Clear to slightly hazy, greenish blue
Z-Phos™	Clear to slightly hazy, blue
Zap®	Clear to hazy, brownish

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