

# Soil

I make a light, airy soil by combining:

- 50-60% - **Pro-Mix HP** (a soilless medium which contains 35% perlite)<sup>1</sup>
- 20-25% - **Kellogg Patio Plus** potting mix (this makes soilless a soil)
- 20-25% - perlite (for better drainage; faster drying).

For every gallon of this mix, I add 1 to 1-1/2 Tbsp dolomite lime. (See the lime section below for more information.).

Hint: When putting together the above soil components, use a scoop of a known volume (like an empty margarine tub) and keep track of the total volume of scoops. Add enough dolomite for that.

I find that 2-1-1 scoops (50-25-25%) creates a more soil'ish mix which takes a little longer to dry. 3-1-1 scoops (60-20-20%) dries a little too fast for me. I do something in between: 3-1-1 (60-20-20%), but the soil and perlite scoops are *heaping*.

## 1. Why I like this soil

New growers often suffer from a soil that's too dense/heavy/rich; stays too wet too long. For example:



(click for larger)

IMO, it's best to add perlite to any bagged soil/potting mix. I would err on the side of too much perlite than not enough. These photos show the texture of my soil (dry & wet):



<sup>1</sup> When I began growing, I used Pro-Mix HP (with 25% more perlite added). This was soilless growing. I used General Hydroponics Flora Series 3-part, a hydroponics product. I followed the "Useless" schedule: <https://forum.growkind.com/threads/gh-3-part-useless-formula.33799/> . It worked very well. If I did it again, I would probably reduce the strength 10%.

I wanted to grow in soil to use less-expensive soil fertilizers, with more organic components (not hydro nutrients with entirely synthetic nutrients). I wanted the soil to be fast-drying (like my soilless experience), but with some soil to promote the microbes necessary for soil fertilizer to be made available to the plant. Myself and friends noticed a distinct taste difference (richer, smoother). People say that's not possible. "Nutrients are nutrients." But, we definitely noticed a difference.

Note: That's a Jiffy Pellet in the soil. **I don't use those anymore.** They're too dense, stay wet too long. And the netting impedes the roots. Below, I explain how I improve upon that.

I like this soil because it's fast-draining and dries in 2-3 days (after the plant's roots have grown into the container).

From my experience, cannabis likes frequent wet/dry cycles. It doesn't like staying wet. A total drench (enough volume for at least 10% runoff), and becoming very dry before watering again (not dry enough for the leaves to wilt. But, the container should feel alarmingly light when lifted.). That cycle from wet to dry should be 2-4 days. If it took longer, the roots stay wetter longer than I believe cannabis prefers. Also: because the soil has no nutrients (you provide nutrients each watering), if it takes longer to dry, it takes longer to supply fresh nutrients.<sup>2</sup> You'll be tempted to water/feed sooner -- which contributes to the roots staying wet (never becoming dry enough).

HINT: As an educational experience, it's a good idea to let a plant dry until the leaves wilt. They'll bounce back 20 minutes after watering. Before watering, lift the container. This will let you know what "too dry" feels like. Keep in mind: this is a stress to the plant. I wouldn't do it to a seedling nor flowering plant. But, it's a useful trade-off compared to always watering too early, keeping the roots constantly wet (a *very common* beginner problem).

## 1.1. Nutrient content

Another positive is that this soil has very low nutrients. Enough for the first two weeks. I [start feeding](#) 1/8th strength the second week after sprouting. I increase the strength each feeding (1/4th, 1/2), starting the third week at full strength.

## 2. Preparation before planting

Before planting, I fill the containers and completely wet them a couple times (allowing them to completely dry between wettings). I think this lets the dolomite lime react, settle down.

### 2.1. Germination in soil (seedling bed)

I don't plant seeds directly in this soil. I feel like the soil texture is too chunky for a delicate sprout. Instead, I scoop out a small (1 Tbsp) amount, and replace it with a fine-textured "seed bed."

I make this seed-bed material from the contents of "Jiffy Pellets" and crushed/fine perlite. I don't like to germinate in Jiffy Pellets because they seem too dense (stay too wet too long). And, the netting interferes with the roots. But, the fine peat material seems perfect when mixed with fine perlite.

I soak Jiffy Pellets; cut the netting; scoop the material out & let it dry. I put some perlite in a plastic bag, step on it a few times until it's broken into a consistency of sand and powder. I mix this fine perlite with the dried peat. I mix a ratio between 2:1 and 1:1 (peat to perlite).

These photos shows the texture of the seedling mix:

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<sup>2</sup> There are different ways of looking at this. A real "soil" would be fully amended and composted, supplying everything the plant needs. I began growing "soilless" and force-feeding hydro nutrients each watering. I carried that into soil growing. I.e., I like being more in control of what the plant is receiving. But, my medium isn't soilless. It uses [soil fertilizers](#), organic sources of nutrients, etc. I like to supply those continuously rather than have a rich/dense prepared soil. I think cannabis prefers this. I think it's the proverbial best of both worlds. Not synthetic nutrients (like soilless). But, not dense/rich soils that are slow-drying.



When I plant a seed in the soil<sup>3</sup> (which I wet/dry 2-3 times before using, as mentioned above), I scoop out a tablespoon of soil from the center, and replace it with this fine peat & perlite mix. I think this seed bed's drainage/drying matches the soil's. If I used the Jiffy Pellet material by itself, it remains wet/heavy while the surrounding soil dries.

## 2.2. Transplanting

I mentioned above that I wet/dry the soil a few times before planting a seed in it. However, I don't do that before transplanting.

When transplanting, I fill the bottom of the larger (new) container with enough potting mix so the top of the soil (in the small/old) container sets high enough (in the new container). I pre-wet that bottom layer; set my rootball on top; fill the sides with dry potting mix; then thoroughly soak all of this.

I use [water](#) with a light amount of flowering (high PK) nutrients. Maybe 100pm of nutrient added to the water. Normally you would never pour runoff back into the soil. But, when wetting new soil, I pour the runoff saucer back into the soil to ensure the peat is saturated. (Dry peat can be impervious to water. If you didn't reuse the runoff, you'd use *a lot* of water.).

## 3. A closer look at the components of the soil

If Pro-Mix and/or Kellogg Patio Plus aren't available in your area, these photos show the texture of the individual components, which could help to recreate what I do.

### 3.1. Pro-Mix HP



Pro-Mix HP contains peat moss, 35% perlite, dolomite lime and myco.

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<sup>3</sup> I don't pre-soak the seed. I have tried the "paper towel method." I didn't like constantly removing the top plate, examining the seeds. I felt I was potentially disturbing them too much. If I didn't look often enough, a root could emerge and attach to the towel.

I tried soaking seeds in shot glasses filled with a water and hydrogen peroxide mix. (5 parts water to 1 part 3% hydrogen peroxide. This makes a 0.5% hydrogen peroxide.). I liked this much better than the "towel method." But, it seemed pointless. It's nice to see the seed crack open, and know it's viable. But, if it doesn't... there's nothing you can do about it. I felt like: Why not just put it in the soil and let it do its thing the normal way?

In theory: you should be able to use an ordinary bale of ordinary sphagnum peat moss, add 35% perlite, lime and myco.

For myco, Wallace Organic Wonder "Premium Mycorrhizal Inoculant" looks like a [bargain compared to typical hydro-shop products](#).<sup>4</sup> Add 15-16 grams per gallon of soil.

The lime part is confusing because I've heard Pro-Mix doesn't have enough. That's why I add 1 to 1-1/2 Tbsp/gal to my final mix. It's hard to know how much to increase that amount for an ordinary peat which has no dolomite. I might go up to 2 Tbsp/Gal, and do more wet/dry prewetting (in the containers) before using it. Maybe 2 weeks? (Maybe 2.5 Tbsp/gal. But, that sounds high.).

I would probably soak/treat/dry the peat before mixing. Dry peat can be impervious to water. So, I would add 1 tsp plain dishwashing liquid to each gallon of water. This acts as a surfactant,<sup>5</sup> helping the water cling to the surface of the peat and soak in. The soap should be unscented, uncolored, no anti-microbial additives. You can usually find "green" (environmentally friendly) soap at the grocery store. I might use hydrated lime (3/4 tsp per gallon of water) to make a fast ph adjustment to the peat.

Note: there is a Pro-Mix BX product. It contains less perlite, and includes vermiculite. This soil dries slower, retains water longer. This is commonly used under HPS lights which can dry the soil too quickly.

### 3.2. Kellogg Patio Plus



This turns the soilless peat into a soil (something for the beneficial microbes to exist in). The label says Patio Plus has an NPK 0.30-0.10-0.10. That would be strong to grow in by itself. But, as 20-25% of the total volume of potting mix, it's not much.

The ingredients are: "Aged recycled forest products, aged rice hulls, composted poultry manure, perlite, peat moss, hydrolyzed feather meal, dehydrated poultry manure, dolomite & oyster shell limes (as pH adjusters), bat guano, kelp meal, worm castings."

It has wood chips which can be a bit large. I take the time to break these into smaller pieces when they stand out to me. It has an insignificant amount of perlite (5%?).

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4 Wallace contains the myco strain: Rhizophagus intraradices. Products like Xtreme Myco contain the same thing. Wallace is substantially less expensive.

5 Real surfactants exist, like [Aquatrols Revolution](#).

### 3.3. Perlite



I use Therm-O-Rock perlite. It comes in a large green plastic bag.

If you use something else, beware of products which have nutrients built into them. MiracleGro's Perlite product has nutrients added (0.07-0.07-0.07). I would rinse/flush that before adding it to the soil mix.

### 4. Lime

When mixing my soil, I add 1 to 1-1/2 Tablespoons (3 to 4.5 teaspoons) of dolomite lime.

However, dolomite has a calcium-to-magnesium ratio 1.62 to 1. Cannabis prefers a range between 2:1 and 4:1. Dolomite's ratio is good enough. I mix calcitic lime with dolomite to get closer to a 3:1 ratio.

This has to be done by weight because the different limes have different weight:

1 Tablespoon of "Fertilome Hi Yield Agricultural Lime" (dolomite) weighs 24.7 grams

1 Tablespoon of "Spartan Speedi-Grow" calcitic lime weighs 16.6 grams

For simplicity: mixing equal amounts (by volume) creates a **Ca:Mg ratio of 2.74 to 1**. For example:

To make 1 Tablespoon *total lime*, mix 1/2 Tablespoon (1-1/2 tsp. 7.4ml) of each (12.35g dolomite & 8.3g calcitic.).

To make 1-1/2 Tablespoon total lime, mix 3/4 Tablespoon (2-1/4 tsp, 11.1ml) of each (18.5g dolomite & 12.5g calcitic).

For a **2.32 to 1 ratio**:

To make 1 Tablespoon *total lime*, mix 5/8 Tablespoon (0.625 Tablespoon, 1.875 teaspoon, 9.24ml) dolomite (15.4g) with 3/8 Tablespoon (0.375 Tablespoon, 1.125 teaspoon, 5.55ml) calcitic (6.2g).

To make 1-1/2 Tablespoon total lime, mix 15/16 Tablespoon (0.938 Tablespoon, 2.81 teaspoon, 13.87ml) dolomite (23.1g) with 9/16 Tablespoon (0.563 Tablespoon, 1.69 teaspoon, 8.32ml) calcitic (9.3g).

For a **3 to 1 ratio**:

To make 1 Tablespoon *total lime*, mix 7/16 Tablespoon (0.438 Tablespoon, 1.31 teaspoon, 6.48ml) dolomite (10.8g) with 9/16 Tablespoon (0.563 Tablespoon 1.69 teaspoon, 8.32ml) calcitic (9.3g).

To make 1-1/2 Tablespoon total lime, multiply the above by 1.5: 21/32 Tablespoon (0.657 Tablespoon, 1.97 teaspoon, 9.71ml) dolomite (9.72g) with 27/32 Tablespoon (0.845 Tablespoon, 2.54 teaspoon, 12.49ml) calcitic (13.95g).

## 4.1. Types of lime

The topic of lime is confusing because there are different types of slow-acting lime (dolomitic and calcitic). And, there is a very strong and fast-acting lime called hydrated or slack lime **which will kill your plants** if you confuse it with dolomite or calcitic. Furthermore, these limes are referred to by a variety of names.

### 4.1.1. Carbonated limes

Slow-acting limes contain carbonated forms of Ca and Mg ( $\text{CaCO}_3$  and  $\text{MgCO}_3$ ). They break down slowly, raising pH as they do, and releasing elemental Ca and Mg. They are often referred to as *garden* or *agricultural* lime.

#### 4.1.1.1. Dolomitic

A safe way to identify dolomite is the label. Dolomite is characterized by calcium & magnesium *carbonates* at a ratio of 1.2 to 1. For example: I use [Fertilome Hi-Yield Agricultural Limestone](#). Its label reads:

```
Calcium (Ca) . . . . . 21%
-- 21% water soluble calcium
Magnesium (Mg) . . . . . 13%
Calcium carbonate ( $\text{CaCO}_3$ ) . . . 54%
Magnesium carbonate ( $\text{MgCO}_3$ ) . . 45%
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As you see: the carbonates (54% and 45%) have a ratio 1.2 to 1. The *elemental* Ca & Mg (released as the carbonates break down in acid) are 1.62 to 1.

#### 4.1.1.2. Calcitic

Calcitic lime is identified by its very low magnesium. This label comes from "Spartan Speedi-Grow Agricultural Limestone."

```
Calcium (Ca) . . . . . 30%
Magnesium (Mg) . . . . . 3%
Calcium carbonate ( $\text{CaCO}_3$ ) . . . 75%
Magnesium carbonate ( $\text{MgCO}_3$ ) . . 12%
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In this case the carbonates have a ratio 6.25 to 1. The elemental Ca & Mg are 10 to 1.

#### 4.1.1.3. Texture

The texture of carbonated lime affects how quickly it breaks down. It should be between beach sand and flour/powder. It's good to have variable consistency (as the Fertilome product does) because the fine texture will work faster, the coarse will last longer.

Some products are very coarse, or pelletized. You can crush it into smaller bits. (Wear a mask to avoid breathing the dust.)

### 4.1.2. Hydrated Lime

There is another type of lime which is very strong and caustic (fast acting). **Do not use this!** It's called [calcium hydroxide](#) (sometimes called hydrated, horticultural, slack, builders' or quick lime. Sometimes: "cal."). **Pay attention to the label.** This lime will contain little (or no) magnesium. It is made of *oxides*.

This is the label for Fertilome Hi-Yield Horticultural Hydrated Lime:

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Calcium (Ca) . . . . . 51.00%
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Calcium Oxide (CaO)	. . . . .	72.50%
Calcium Hydroxide (Ca(OH) <sub>2</sub> )	. . .	95.79%
Magnesium Oxide (MgO)	. . . . .	0.45%

This lime has limited usefulness: fine-tune the starting pH of soil. This is not something you would play with until you've grown awhile.

It can also be used to flush an acidic soil to raise pH in the middle of a grow. But, that's very unusual to do. Typically, just flushing (100% runoff) with plain water (or 1/4-strength nutrients) is enough. For example, 1/2 tsp hydrated lime in 1 gal of water could treat a very acidic soil. But, this is the **last** thing you should do. Typically acidic soil is from overfeeding and not enough runoff over time. It's **not** usually a *soil* problem.

## 5. pH

The dolomite lime will stabilize the soil's pH through the grow. However, it can be useful to fine-tune your starting soil pH. I usually don't. But, it's good to know how to do it.

There is a "slurry" method of testing soil pH.<sup>6</sup> There is also the "NCSU pour-through extraction method."<sup>7</sup> However, these require a pH pen. Since I don't pH my nutrient solution,<sup>8</sup> these method aren't desirable for me.

However, I do use a soil pH probe. These are not entirely accurate. Especially the inexpensive ones you find at garden centers, hardware stores. But, I have a fairly expensive "Control Wizard Accurate8 soil pH probe."<sup>9</sup>

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6 Take 2 fl. oz (volume) of soil, and the same amount of distilled water. Let soak until the soil is saturated (10 minutes?). Measure the pH using a pH pen.

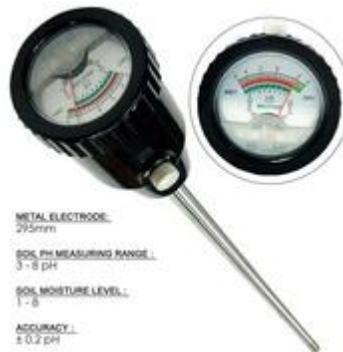
7 <https://content.ces.ncsu.edu/the-pour-through-extraction-procedure-a-nutrient-management-tool-for-nursery-crops>

8 I don't pH my nutrient solution because it's simply not necessary in soil if you don't feed too-strong nutrients. The soil has pH buffers which will pull the solution's pH to it (not the other way around). If the nutrient solution is strong, or acidic because hydroponic/synthetic nutrients are being used, then the soil pH can be affected. But, if you use soil nutrients at a reasonable strength (200-400ppm), pHing isn't necessary.

One problem with pH'ing nutrient solutions is that you'll typically use PH-UP products which contain nutrients. The bottles don't show this because it's not sold as a fertilizer. People typically feed too strong, which causes salt buildup in the soil, which acidifies the soil. The stronger the nutrient solution is, the more PH-UP they have to use. This adds more salts to the soil. The grower will typically measure the pH of the runoff, see that it's becoming acidic. They'll try to counteract this with higher pH nutrient solution -- which means adding more PH-UP, which adds even more salts to the soil.

It's a vicious cycle. If you don't feed to strong, not only will you not get salt buildup in the soil. But, the nutrient solution won't need much PH-UP to move its pH. That is an indication that the soil will pull the solution's pH, not the other way around. At that point, just don't pH anymore. No more delicate pH pens. No more calibration solutions. No more probe cleaning and storage solutions. No more bottles of UP and DOWN.

9 Helpful hint: The Accurate8 soil pH probe comes with a pad to burnish the probe's surface between uses. This piece doesn't last long. When it wears out, you can use ordinary #0000 steel wool.



I use this to monitor my soil pH while growing. And, also check the mix before using it.

I don't use this probe much anymore. What I've seen is that soil goes through a 1 to 1.5 point range from wet to dry. And, if I don't overfeed (and have sufficient runoff), I don't get salt buildup which would pull that range lower.

During the grow, I've found that monitoring runoff PPMs is a more useful gauge of where my soil is. This number seems meaningless during veg. It stays in the 500-1000 range. But, after transition this number starts climbing. If it reaches 2400-2500, that's where lockout occurs. I try to keep my nutrient strength and runoff volume sufficient to be around 1600-1800. If it goes above 2000, I decrease strength and pour more volume. If it goes over 2200ppm, that's the danger zone. At that point I would feed 1/2 strength, and pour enough volume for 100% runoff. (However, now that I have strength/runoff dialed in, I rarely watch runoff PPMs. Maybe 1-2 times in mid flower.)

It can be informative to probe your soil *and* monitor runoff ppms. What I saw is that the soil ph went lower as the runoff ppms increased. A very definite correlation. That was informative to watch.

It can also be beneficial to test your mixed soil before using it (e.g., when you buy a new bag of Pro-Mix or Kellogg). Amending 1.8 grams (3/4 tsp) hydrated lime into a gallon of soil will raise the pH one point. Or, 6 grams of aluminum sulfate will lower the pH one point.

## 6. Soil aeration

I accidentally discovered using my soil pH probe that cannabis really likes having the soil aerated. In flower, when the soil is more compacted, I use a 1/4" diameter aluminum rod to poke holes through the soil (straight down to the bottom, sideways through the root ball).

I put the rod in a drill bit and spin it while holding the tip against a steel file. This let me put a rounded/pointed tip on the end (to hopefully not damage the roots as much). Then I created a handle by bending 4" (of the other end) 90-degrees. I used a rod 18" long. The result is about 14" tall.

## 7. Runoff saucers

Because I typically water enough volume for 10-20% runoff, I find the typical gardening saucer too shallow. I made my own deep saucers using 5-gallon Home Depot buckets:



I made marks all the way around the bucket, 4-1/4" (10.8cm) from the bottom. Then I connected those dots using painter tape. I use that tape as a guide to cut the bucket wall with a hacksaw.



Cut until the blade breaks through a little, then rotate the bucket and do it again. If you try to enlarge one cut too much, letting the blade go deeper, the cut will travel off center. More, shallower cuts is better. Connect them all together.

Those "saucers" are good for 3gal containers. Smaller buckets are good for 1 & 2gal containers.

I use a wet/dry "bucket head" vac (Home Depot) to suck the runoff out of the containers. It attaches to a 5-gal bucket. A narrow hose-end attachment is available which makes it easier to reach the bottom of the "saucer."



Harbor Freight has a few inexpensive pumps. The two hand-operated pumps would work better with a PVC pipe attached to the flexible tube (so you can hold that to the bottom of the “saucer” while pumping. Maybe clip the other end to the edge of the bucket you’re pumping runoff into.). The battery-operated transfer pump shown on the right would be easier to use. But, I used one of these (different brand) and it didn’t last long. It seemed the corrosive runoff damaged the motor.



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[https://drive.google.com/open?id=1RGCpjJyySatwc\\_ohj0UKe8SKxT8cN3L9](https://drive.google.com/open?id=1RGCpjJyySatwc_ohj0UKe8SKxT8cN3L9)

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