

A quarterly publication for growers

# BOTANICARE® GROW GUIDE

## GROW OUTSIDE

### PHOTOPERIODISM

DAY LENGTH AND PLANTS

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WATER QUALITY'S ROLE  
IN A SUCCESSFUL GARDEN

### VERMICOMPOST

INCREASE YOUR SOIL'S  
FERTILITY USING WORMS

### PREP YOUR SOIL

SOIL CONDITIONING 101

### PREP YOUR PLANTS

ACCLIMATIZE IN 7 DAYS

# PHOTOPERIODISM

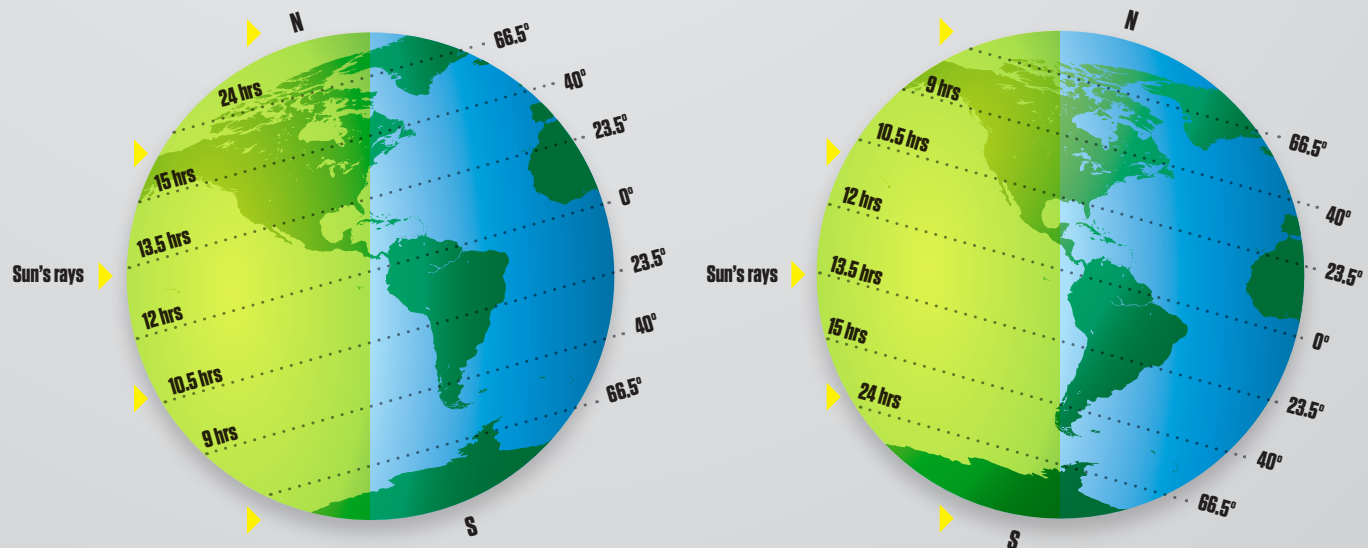
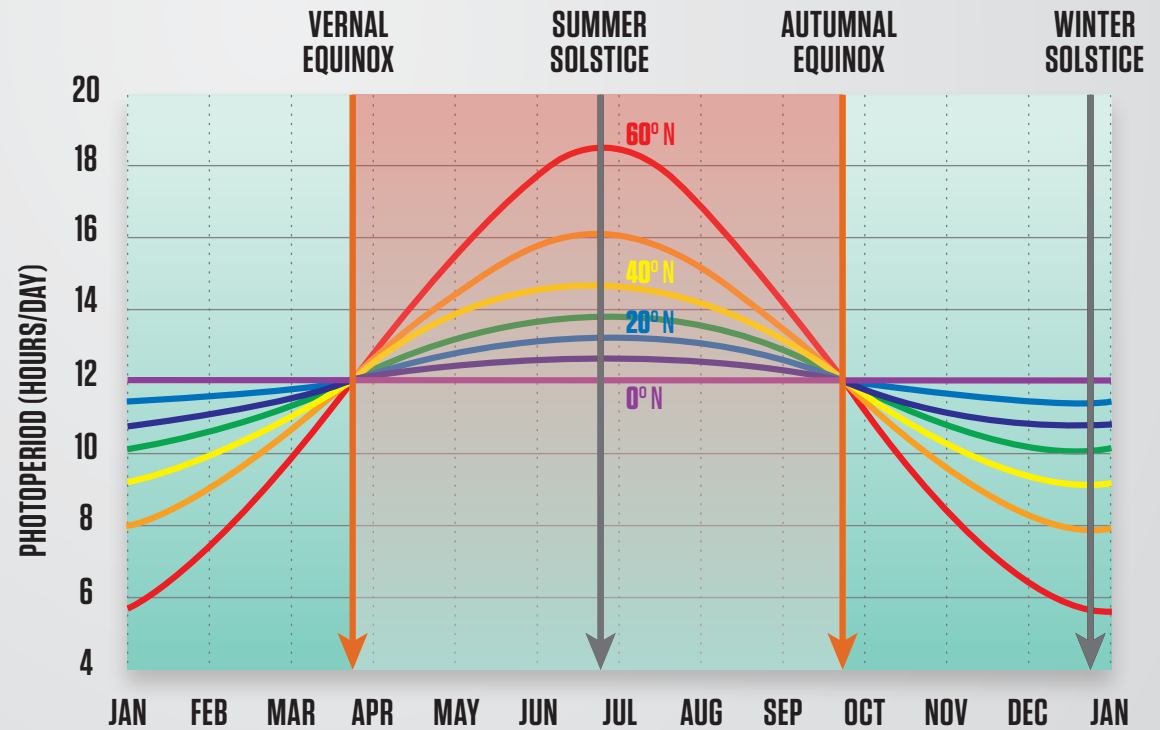
is the physiological reaction of organisms to the length of day or night.

## EQUINOX: EQUAL DAY AND NIGHT

There are two distinct dates called equinoxes, vernal (spring) and autumnal (fall) that mark the point at which the day length is the same at the equator as the Arctic Circle! The vernal equinox occurs around March 20th each year and the autumnal equinox occurs around September 22nd. Gardeners growing crops that require a certain number of hours to maintain vegetative growth or to trigger flowering and fruiting growth must know the length of day to accurately plan their crops and harvests. The equinoxes are highly significant for gardeners because they indicate the correct time to plant photoperiod sensitive crops outdoors in the spring and fall for summer growth and fall harvest. As well as shifting to longer days in the spring and shorter days in the fall.

## DAY LENGTH

The angle of the sun's rays with respect to the tilt of the earth will determine the length of the day depending on the time of year and the hemisphere in which you live. In the northern hemisphere (above the equator), the longest day of the year is called the summer solstice and the shortest day of the year is called the winter solstice.





# HOW TO ACCLIMATIZE (HARDEN OFF) ROOTED PLANT CUTTINGS IN 7 DAYS

By Brandon Jewell



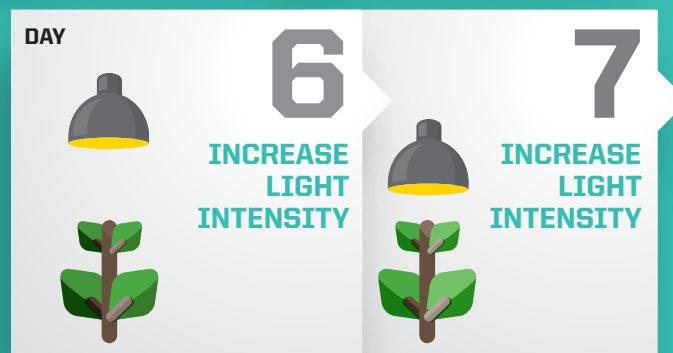
## REDUCE HUMIDITY

- A) Humidity dome with vent:** Open vent for 2 days then remove dome on 3rd day.
- B) Humidity dome with no vent:** Remove dome for a couple hours per day, then remove dome on 3rd Day.
- C) No dome:** Discontinue foliar sprays or misting to reduce moisture around the plant leaves.



## ADD NUTRIENTS

Begin watering using a half strength nutrient solution (500-700ppm) to introduce new plant roots to nutrients prior to transplanting to reduce transplant shock.



## INCREASE LIGHT INTENSITY

Move the plants into an area of higher light intensity by moving the source light closer to the plants or by moving the plants from the propagation area to the growing area being mindful of the differences in intensity from the two environments.

**Transplant!** Plugs or bare rooted cuttings should now be acclimatized with a minimal amount of stress and are now ready for your preferred growing substrate and fertilization program.

# Soil Conditioning 101

## Better growing through chemistry

At the beginning of every planting season many gardeners begin the ritual of tilling up soil and preparing both new and old garden beds. Before hauling out the old pickaxe and shovel, consider some simple, chemical properties of soil that can be manipulated to increase its quality. Through the use of a few agricultural substances, a lifeless plot of dirt can be cultivated into a thriving garden without breaking the bank or your back.

Connor Osgood, Botanicare



### Initial Soil Assessment

Preparing soil to grow healthy, productive plants is not rocket science, but does require some planning and forethought. It is imperative that your soil's chemical qualities are assessed before cultivation. An inexpensive soil test can provide an accurate representation of the soil. A composite sample should be collected by combining several smaller samples from the area, and sent to a local agricultural lab to have it tested for basic parameters such as NPK concentration, calcium, micronutrient concentration, and pH. The pH of the soil can be tested at home using a digital pH meter or chemical pH-indicating test paper. Simply gather a completely dry soil sample and hydrate it

slowly with distilled water until it is fully saturated with as little excess water as possible. Then insert the probe or test strip into the soil paste.

### Modification of Soil pH

Since some of the most common problems tend to be pH-related nutrient deficiencies, the initial pH testing can reveal the changes that must be made. Soils which are more basic (higher pH), are composed of layers of clay which possess a net negative charge, meaning that cationic (positively-charged) plant nutrients such as calcium, magnesium, and iron will adsorb to their surfaces and potentially become fixed, or unavailable to plants. Conversely, acidic (lower pH) soils are

made of particles with a net positive charge, causing important anionic (negatively-charged) plant nutrients such as nitrate, phosphate, and sulfate to become fixed. Additionally, acidic soils may provide toxic amounts of metals such as aluminum, iron, and manganese. In order to prevent crippling nutrient deficiencies in most crops, the soil pH will need to be decreased if above 7 or increased if below 6.

Increasing the pH (liming) of an acidic soil is relatively straightforward. There are many inexpensive compounds available for this purpose. Such compounds include pure calcium carbonate ( $\text{CaCO}_3$ ) or agricultural limestone (the mineral in which calcium carbonate naturally occurs), magnesium-containing dolomitic limestone, wood ashes, and ground oyster shells. These substances neutralize hydronium ions, the concentration of which is exactly what pH measures, in the soil solution. Agricultural limestone is perhaps the most practical of these liming agents due to cost, but some of the others may provide additional nutrients.

Acidifying alkaline desert soils is notably more difficult due to the time required for acidifying materials to break down and take effect. Elemental sulfur is a direct way of lowering soil pH, but requires 4-6 weeks to break down with the help of ubiquitous soil bacteria. When elemental sulfur is incorporated into the soil, it is first present in the reduced form, but over time it oxidizes after exposure to oxygen and water, and releases hydronium ions into the soil solution. Ammonium ( $\text{NH}_4^+$ ) fertilizers will also oxidize to release acid after soil application, providing much-needed nitrogen to the soil. It should be understood that gypsum (calcium sulfate,  $\text{CaSO}_4$ ) or any sulfate fertilizers do not decrease soil pH as many gardeners assume. The sulfate anion is already



present in an oxidized form, and will not release hydronium to the soil solution. While not usually the primary reason for its incorporation into soil, organic matter can also be used to decrease pH. Addition of organic matter to the soil produces  $\text{CO}_2$  in pore spaces, which subsequently creates carbonic acid in the soil solution.

### **Soil's Physical Properties**

Unfortunately, altering a soil's physical properties is not as practical as changing its chemical properties such as nutrient concentration or pH. However, some simple steps can be taken to change the most important of these physical parameters such as porosity, water-holding capacity, and aggregation, or the way in which clay particles are distributed.

Regardless of initial soil type it is always beneficial to add organic matter such as compost, crop residue, or organic material to introduce carbon. While these materials provide plant-available nutrients and foster microbiology, organic matter improves the water holding capacity and porosity of soils. Additionally, soil carbon behaves similarly to clay in that it is surrounded by negative charge which allows it to store many cationic nutrients for later use by the plants. This phenomenon, known as cation-exchange capacity (CEC), helps regulate soil fertility and can prevent some nutrients from being washed away.

The presence of sodium in many soils is a natural but highly problematic condition which prevents effective water penetration. Soils high in sodium form a crust at the surface which causes water to roll off before it has a chance to percolate downwards. Although gypsum does not affect soil pH, it is very effective at removing sodium. Additionally, adding gypsum is very inexpensive way to improve the water penetration

and structure of clay soils. After dissolving in the soil solution, the calcium sulfate present in gypsum ionizes and the calcium cation begins to compete with sodium cations for adsorption to clay surfaces. In the process of flocculation, the attraction between calcium and the negatively-charged clay surface is much more energetically favored than that of sodium, and the sodium ions are displaced. To obtain the greatest benefit, apply the gypsum and dig it into the first few inches of the soil. The soil should then be heavily irrigated.

### **Soil Fertility**

Nutrient concentration in soil (or lack thereof) is often the most limiting factor in terms of plant growth besides water availability. Of the essential plant nutrients, nitrogen is the most critical and often most deficient. Nitrogen is extremely soluble and leaches away from soil quite easily. Application of a nitrogen-containing fertilizer during soil preparation is essential to ensure productive growth. Nitrogen is also one of the most diverse nutrients as it comes in

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many forms, both inorganic and organic. While only the inorganic forms ( $\text{NO}_3^-$  and  $\text{NH}_4^+$ ) can be assimilated by plants, the nitrogen in organic sources such as fish emulsion or animal manure will eventually convert to plant-available forms. Unlike synthetic nitrogen fertilizers, organic materials provide the additional benefit of contributing other nutrients as well as soil carbon.

Phosphorus is often the second-most limiting plant nutrient, but unlike nitrogen which washes away with ease, it is extremely immobile in soil. In

fact, Phosphorus is so immobile that plant roots cannot utilize it unless it is located extremely close to the root surface. Phosphorus fertilizer should not be applied until after plants have begun to grow, and should be applied in thick bands right near the root zone. Unfortunately, many natural phosphorus fertilizers like bone meal or rock phosphate are unsuitable for use in high-pH soils, as they form incredibly insoluble compounds. Instead, synthetic ammonium-phosphate fertilizers or animal manures are recommended. Animal manure can be surprisingly high in Phosphorus and if it is being used to meet a plant's nitrogen demand, chances are it will provide an appreciable amount of Phosphorus if applied near the root zone.

With the exception of potassium, in heavily leached soils, nitrogen and Phosphorus are typically the only two nutrients that need to be applied to most soils in major quantities. The rest of the essential plant nutrients are usually present in high enough concentrations to meet plant needs and do not need to be added, as their availabilities are dictated by pH. For example, calcium and metal micronutrients like iron and zinc are more than abundant in many Western United States soils, but do not become available until soil pH decreases. In the acid soils of the Pacific Northwestern, Midwestern and the Eastern Coast states, calcium requirements may be met simply by applying lime. To reiterate an earlier point, a soil test will indicate exactly which nutrients are present or lacking in a soil and many labs will make recommendations for fertilizing as well. Lastly, when applying any type of product to soil, whether it's organic fish emulsion or ammonium polyphosphate, it is important to follow the manufacturer's listed application rates to avoid damaging plants.



## AND WATER QUALITY FOR HYDROPONICS

Water makes up as much as 90% of the mass of a plant- even more in some crops, such as lettuce. To get to that level our crops will “drink” a lot of water- as much as three gallons to make one single tomato. For these and other reasons, the quality of your feed water plays an instrumental role in the success of your garden.

### Where to start

For hydroponics, you will need two tools: a pH meter, and a total dissolved solids (TDS) meter, also known as an electrical conductivity (EC) meter. A meter is only as good as its calibration; calibrate your meters using the instructions provided with the meter, using calibration solutions from your hydroponics store. If you don’t feel like calibrating your meter before each use, do it once a week- and then do a “cal check,” testing against your calibration solutions before use. TDS meters are more robust than pH meters, and the probe on pH meters is prone to burning out or breaking.

*Tip: pH probe life can be extended by cleaning and storing as recommended by the manufacturer.*

### Water Hardness

The “hardness” of your water is determined by the concentration of salts dissolved in it as it

comes from the source. Hard water requires the roots to expend more energy to uptake the water and nutrients used for plant growth. Obviously, using better water gives your plants a head start. If your water comes from surface sources such as a reservoir or river in a moist climate, its hardness may be quite low (under 100 ppm), and this hardness may be due to ions such as calcium and magnesium that plants can actually use. If your water is very hard- over 150 ppm or so- you may want to buy purified water or install a reverse osmosis (RO) unit in your home or greenhouse. Don’t use a water softener- they add salts that make for better suds in the shower, but not better plants in the garden!

*Tip: Water quality may change throughout the year. Check it regularly for best results.*

### pH

pH is a measurement of how acid or alkaline a solution is. For most plants, a pH between 5.0

and 6.0 is adequate. Plants in deepwater culture are more sensitive to pH outside the appropriate range, while soil and coir are more forgiving. Your meter and probe should be calibrated with pH 4.0 and 7.0 solutions since you will be measuring within this range.

Once you have added nutrients to your water, based on the manufacturer’s recommendations, mix well and test the pH. A pH outside the acceptable range can be adjusted by adding the proper solution, such as pH Up or pH Down. Be careful not to use too much- a little goes a long way. Dose, mix thoroughly, and test again. A pH outside the recommended range is one of the leading causes of problems in hydroponics. A pH that is too high or too low quickly causes deficiencies, meaning more headaches for you. Remember- the pH may change as plants grow and change the water chemistry. Testing and adjusting the pH between water changes will help keep your plants growing at their best.

*Tip: pH papers are an inexpensive backup for your pH meter. Those fragile probes tend to break at the worst possible times!*

### Chlorine

Chlorine (or chloramine) may be added to tap water in order to kill potential pathogens. Aerating your water for a period of 24 hours or running the water through a charcoal filter will help remove the chlorine. Also, boiling water for approximately 15 minutes will drive away any chlorine present. Potassium metabisulfate will remove both chlorine and chloramine when dissolved in water.

### Temperature

Plants tend to thrive within a specific temperature range- so do the roots! If your reservoir is on a cold concrete floor, it can shock the roots every time your plants are watered. A sheet of plywood as insulation can help keep the chill away.

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NUMBER OF GALLONS OF  
WATER IT CAN TAKE TO  
PRODUCE ONE TOMATO



# VERMICOMPOSTING

REDUCE, REUSE, RECYCLE WITH THE HELP OF WORMS

Many of today's gardeners want to improve their land's fertility while also supporting green efforts. One option stands out as a must-have for all our backyard gardens – worm castings. Worms break down all sorts of organic material during their digestion process. This process, known as vermicomposting, yields some of the highest quality soil amendments available and helps create successful, hassle free gardens while conserving resources.

Current research shows extremely complex benefits from the use of worm castings in agriculture. Considered a green technology, vermicomposting is the epitome of the slogan: reduce, reuse, and recycle. Our growing knowledge of these largely unnoticed creatures shows a fascinating connection between worms and the earth's overall ecosystem health. Their effects on soil biology, nutrient availability, and the complexity of their decomposition of organic materials, are some of the things currently being studied.

Although we are just starting to understand the relationship between earthworms and healthy soils, worms have been fascinating people for millennia. For example, Cleopatra, Queen of the Nile, decreed that worms were sacred and therefore not to be harmed. The Greek philosopher, Aristotle, declared them to be the guts of the soil. The great biologist, Charles Darwin, best known for his theory of evolution, started his scientific work looking at earthworms. He was fascinated by them and utterly convinced that worms were among the unsung heroes within the natural world; and in 1881 he published his lifelong research on earthworms.

Vermicompost (worm castings) stimulate plant growth even when plants are receiving optimal nutrition. Improved seed germination, accelerated growth and development, and increased productivity and yield are all scientifically validated claims. Other benefits, such as disease prevention and the ability to repel pests are also possibilities.

When compared to regular compost, vermicompost stands out as the winner. Higher levels of plant-available nitrogen, phosphorous, potassium, sulfur, and magnesium make vermicompost nutritionally superior. Microbiology is also more complex in vermicompost than standard compost. Why? First, vermicompost is processed at a moderate temperature range that never comes close to the 60° C or higher achieved in standard “hot” (thermogenic) traditional garden compost. This means that worm castings have more microbes meant to live at lower temperatures when compared to those that live in regular compost. Although the process is not entirely understood, it is also clear that worms release more microbes than they ingest, meaning that they are actually facilitating microbial growth during their constant eating. Many composters believe a temperature of 60° C or higher is required to destroy pathogens. However, surprising new research shows that castings produced in a pathogen-rich environment actually contain no pathogens. Dissections show that something happens within the first 5mm of the worm that completely removes pathogens.

According to some estimates there could be more than 1800 species of worms worldwide providing a wide range of choices when looking for worm castings. Many of the worm castings available in retail shops are produced by African nightcrawlers. Another choice is *Eisenia fetida*, more commonly known as a Red Wiggler, which is indigenous to most parts of the world. This particular worm is extremely tough, adaptable, and able to handle a temperature range from 0-35° C, and the eggs or cocoons can even survive short periods of complete freezing.

Without question, the addition of worm castings can provide gardeners with more vigorous plant growth. For those gardeners up for the challenge, trying small scale worm farming could result in a burst of plant growth while decreasing the waste that leaves your house for the landfill.

## Choose wisely

*When purchasing worm castings, remember, worms are what they eat, therefore their food source is very important. Choose worm castings produced by worms that have been fed a carbon rich, natural diet including organic material like vegetables and fruits, coffee grounds, seaweed, manures and even corrugated cardboard.*

## Use wisely

*Use worm castings as a top dressing or work them it into your medium. The best ratio of castings to mix into your growing medium is about 10%. You can add up to 40%, but using over 40% decreases its value, and can actually slow growth of plants.*



# **GROWILLA<sup>®</sup> VEG**

# **GROWILLA<sup>®</sup> BUD**

## **Natural & Organic Dry Base Nutrients**

### **SIMPLE, BALANCED, ALL-IN-ONE VEG AND BUD FORMULAS.**

This simple to use, natural and organic plant food includes a potent combination of seabird and bat guanos, earthworm castings and fish meal. These, and other natural inputs provide a wide range of food sources for plants and beneficial microbes.

#### **Growilla Veg- for use during the vegetative growth phase.**

As the organic matter in this proprietary blend naturally breaks down, essential elements are gradually released to be safely and easily absorbed by your plants. Growilla Veg was formulated to provide the ideal ratio of macro and micro nutrients each chosen for their ability to encourage lush, vigorous, vegetative growth. Use Growilla Veg Food as a standalone plant food in your garden or with your favorite supplements. Growilla Veg excels in containers, raised beds, and can be tilled into native soil.

#### **Growilla Bud- for use during the bloom phase of fruiting and flowering plants.**

This potent blend of high quality ingredients contains the essential elements needed from transition to harvest. Multiple sources of guano, earthworm castings, fish meal, and other natural inputs provide a wide range of food sources for plants and beneficial microbes. Growilla Bud was designed to be simple and effective, safely delivering what plants need for enhanced flower development, improved soil structure, and increased nutrient uptake. Use Growilla Bud as a standalone plant food in your garden or with your favorite bloom supplements. Growilla Bud's natural formula excels in containers, raised beds, and can be tilled into native soil.

