

A Strong Start: Organic Nutrient Management for Vegetable Transplants



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The Challenge: Nutrient deficiencies are common on organic vegetable farms and can limit plant health and yield. Nitrogen (N) deficiency is typically the biggest nutrient challenge on organic vegetable farms. This is because organic sources of N (such as cover crops and compost) only release a fraction of their total N gradually for plant uptake. Nitrogen slowly accumulates in pools in the soil and is cycled and released over several years. As a result, supplementing with organic N fertilizers is often necessary to meet crop nutrient needs. Nitrogen is essential for plant growth as it is a key component of proteins, amino acids, and chlorophyll. It regulates growth, enables enzyme production, and contributes to cell structure, along with other important roles.

“Nitrogen can be thought of as protein for plants - it is essential for healthy and vigorous growth and may be supplied via several different sources: soil organic matter, cover crops, compost, and fertilizers. Nitrogen in particular is a highly mobile and easily lost nutrient and must be supplied in adequate quantities to meet crop requirements in order to produce a satisfactory harvest.” - Lucas Hill, farmer in the North Bay Area, see this [resource](#) for more info

Nitrogen Sources and Availability: Organic N sources like guano, blood meal, feather meal, and liquid fertilizers are often known as “quick release” N fertilizers because they release a large fraction of their N within a relatively short period of time. Granular fertilizers and manure-based composts release N at a more intermediate rate. Crop residues can be quite variable. Fresh legumes (which have a low carbon:nitrogen ratio) tend to break down and release nitrogen quickly, often within around 4 to 6 weeks. On the other hand, a more woody (carbonaceous) cover crop, crop residue, or greenwaste compost generally do not release much nitrogen, if any, and can even tie up N due to their higher carbon:nitrogen ratios. Crop residues and greenwaste-based

composts release N at a very slow rate, sometimes enabling microbes to immobilize or “tie up” N in their microbial biomass before eventually releasing it back into the soil.

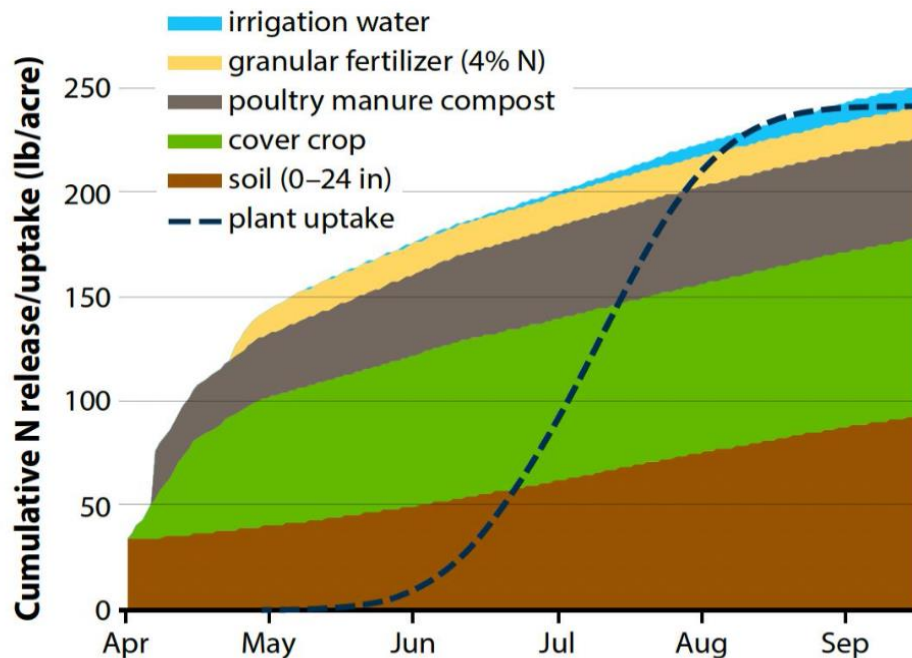


Figure 1. An example of nitrogen uptake and nitrogen supply in an organic tomato field (fresh-market tomato cv ‘Brandywine’). Data are based on a field trial in Davis, California.

(Lloyd et al., 2020 [Estimating Nitrogen Availability in Organic Annual Production](#))

“I’ve seen a lot of beginning organic farmers under-fertilizing their crops, thinking that the native soil and a little compost are enough to get robust crops. But that’s not usually the case, save some lucky souls on super good soil. I’ve always been of the mind that if we’re going to go to all that effort in labor and soil work to plant and cultivate a crop, it financially makes sense to spend the money to make sure plants are getting the nutrients they need to make a robust crop. There is good technical data out there about what crops need (UC Extension has good data) to finish strong. We tend to underestimate how much N our cover crop is providing us (because most of our crops aren’t planted at the ideal time to take advantage of the high end of what cover crops can provide in N), and we also tend to underestimate how much N compost is offering us because we apply it in the fall. Those are more long term savings deposits on our soil. We make up the difference with feather meal, usually 13-0-0 (because our soil is very high in phosphorus). We usually put down feather meal at about 90 lbs per acre on heavier feeding, longer growing crops like corn and potatoes, and 75 lbs per acre on

lighter feeding crops like carrots and beets. We've had good success side-dressing heading brassicas. We fertigate crops that are showing early signs of nutrient deficiency and/or crops that are super important to our bottom line like strawberries."

-David Plescia, Farm Manager, West County Community Farm

Nitrogen Deficiency in Vegetable Starts: Nitrogen deficiencies can show up early in plant development as well as later in the field. Unfortunately, many potting mixes used for transplants are a bit imbalanced for vegetable crop needs. They are often high in carbon (organic matter) and too low in N. This can lead to young seedlings that look pale, yellow, and stunted which are symptoms of N deficiency. To prevent this, it is important to start with a good potting mix substrate that has enough N to support good plant growth and development. Consider purchasing a potting mix that has enough N, or if you make your own, mix in an organic fertilizer to supply sufficient N for rapidly growing young plants.



Nitrogen deficiency symptoms include uniformly pale green or yellow discoloration, small leaf size, and stunted growth (middle and right lettuce leaves, photo credit: CDFA FREP).

Other Plant Essential Nutrients: Along with nitrogen, all plants need several other nutrients too. This includes the macronutrients phosphorus, potassium, calcium, magnesium, and sulfur which plants need in relatively larger amounts. They also need micronutrients in much smaller quantities like boron, copper, and zinc, among others. Phosphorus (P) improves root growth, provides energy for metabolism, and is key for

protein synthesis and genetic material. Organic starter fertilizers commonly have high P content. Bone meal and especially rock phosphate are only slowly available, so they would not be good sources of P for transplants. Their availability is further reduced in soils with a pH above 7. On the other hand, chicken manure, guano, fish emulsion, manure-based vermicompost, or some plant meal should provide P quicker. Potassium (K) improves water regulation, protein synthesis, and stress tolerance. It regulates stomata and supports plant growth, development, photosynthesis and respiration. Some liquid starter fertilizers contain K while others do not.

Example Products: Common examples of commercially available organic potting mix components for vegetable transplants include peat moss, vermiculite, perlite, and pine bark. True Organics, Miracle-Gro, and Peaceful Valley Organics all have organic potting mixes commercially available. One option is mixing peat and vermiculite at a ratio of 7:3 (peat:vermiculite), then adding dolomite at a rate of 22 grams per quart of substrate. In other words, for every 10 quarts of substrate, 7 quarts are peat, 3 quarts are vermiculite, and 220 grams of dolomite are incorporated. Consult the Soil Mixes section of this CASFS resource, [“Organic and Sustainable Seedling Production: a Guide for Specialty Crop Growers,”](#) to learn more about commercial organic mixes, how to make your own mixes, and a Soil Mix Assay to compare and evaluate the quality of different soil mixes at your farm. For more examples of organic substrate options, see Table 1 in this ATTRA article, [“Potting Mixes for Certified Organic Production.”](#) Consider calling the customer service lines of several different companies to compare current prices and availability of potting mixes and fertilizer product options. Anecdotally, several growers in the Sacramento area have had great success fertigating with vermiextract, which substantially increased plant growth and root development. UCCE Advisor Margaret Lloyd has found vermicompost can significantly increase root branching and total root length. Vermiextract and vermicompost are available for purchase from various suppliers such as Central Coast Worm Farm, for example.

Different Needs for Different Crops: While all plants need the same essential nutrients, some vegetable crops are known as “heavy feeders” since they need more nutrient inputs than others. Tomatoes, peppers, and cucurbits are considered heavy feeders, so different fertilizer applications can benefit those plants even before they are transplanted into the field. Research by UCCE advisors Emma Volk and Bruno Pitton suggest applying NPK at the rates outlined in Table 1 will maximize vegetable transplant growth.

During the first few weeks after seeding or transplanting, plants take up only small amounts of nutrients. The potting mix may not need to be different between heavy vs. light feeders. But heavy feeders will require additional nutrients from other sources

sooner than other crops. Over time as the transplants grow and get bigger, their nutrient needs increase. The amount of time they are in the start house and how large they will be at transplanting will affect how much nutrients they need. For transplants in the field, nutrients should be applied within the rootzone. Using starter fertilizer in a band along the rootzone will be more efficient than broadcasting. Fertigation—applying fertilizer through the irrigation system or with the transplanter water wheel—helps provide nutrients in solution which are immediately available for uptake by plant roots.

Table 1: Suggested fertigation rates for different crops in ppm (1 ppm = 1 mg/L)

Suggested ¹ Fertilizer Rates in ppm ²			
	N	P	K
Leaf Lettuce	225	30	170
Romaine Lettuce	380	30	250
Broccoli	400	25	100
Processing Tomato	265	45	120
Celery	400	25	160

¹Fertilizer rates are based on research conducted by UCCE advisors and are used as a suggestion. Consultation with your county Cooperative Extension advisor or fertilizer company is encouraged.

²Research funded by the California Department of Food and Agriculture's Fertilizer Research and Education Program.

Choosing a Fertilizer Product: Once you know which crops you'd like to fertilize in the start house, it can be helpful to call several fertilizer supply companies that offer fertilizers that fit your needs and compare your options. For instance, fish emulsion is a common organic fertilizer that can be applied via irrigation. Other fertilizer products can be incorporated into your potting mix prior to seeding—see Table 2 in the ATTRA article linked above for examples. When choosing a fertilizer product, read the label before purchasing to ensure the product will fit your needs. You can often find labels online or you can ask the supplier for the label. The label will tell you key information such as ingredients, concentration of nutrients present, application rate, methods, timing, placement, equipment needed, etc. This varies depending on the product you choose. Knowing this information will help you make an informed decision.

Action Steps:

1. A good substrate: Start by assessing your current transplant mix. What's it made of? Have you seen signs of nitrogen deficiency in your transplants? If so, which crops? When do you start seeing those signs? Can you buy a higher quality potting mix with more nitrogen, or create your own custom blend to fit your needs? Make sure your transplant potting mix has enough nutrients to give your transplants a strong start.
2. A good fertilizer: What fertilizer(s) do you already have on site? Have you read the labels to ensure you are using them correctly? Which crops would benefit from supplemental fertilization in the start house? Consider what you have, what you need, and reach out to fertilizer suppliers to compare options and make an informed decision.
3. Scout for symptoms & fertigate: Once you start seeing [visual symptoms of nutrient deficiencies](#) (especially nitrogen) you can fertigate your transplants with an organic fertilizer. However, it is recommended that you fertigate prior to the onset of visual deficiency symptoms to prevent the issue whenever possible. These deficiencies will probably show up first in "heavy feeders." They might show up while the transplants are still in the start house, or they might start to show in the field. Pre-plant fertilizer in the field can help prevent issues once your transplants graduate to the field.
4. Record keeping: Keep clear notes about which crops need that extra fertigation boost in the start house, when, and which sources work best. This might take some trial and error to refine over time with your potting mix and different crop types. But eventually you can create a schedule where you fertigate before symptoms show up to proactively prevent deficiencies. You could compare different organic fertilizers to figure out which one works best for you. You could set up comparisons to evaluate whether your substrate and fertility plan are making a difference.
5. Connect: Talk to other farmers to compare notes. What works well for them? Which crops do you both grow from transplants? Consider sharing your own successes and challenges and asking around for helpful anecdotes and tips. Contact your fertilizer suppliers with product-specific questions. Reach out to UCCE for the latest science-based information about organic nutrient management!

Commercial products and brands listed here are included as examples only, not endorsements.

Resources:

[ATTRA Plug and Transplant Production for Organic Systems](#)
[CDFA FREP Crop Fertilization Guidelines for specific crops](#)
[Deficiency Symptoms of Plant Essential Nutrients in Vegetables](#)
[Efficient Nutrient Management in California Vegetable Production](#)
[Estimating Nitrogen Availability in Organic Annual Production](#)
[Organic and Sustainable Seedling Production: A Guide for Specialty Crop Growers](#)
[Organic Nutrient Management Example from Longer Table Farm written by Lucas Hill](#)
[Potting Mixes for Certified Organic Operations](#)

Real World Examples

While there is no one-size-fits-all when it comes to transplant nutrient management on organic farms, it can be helpful to hear success stories from farmers who have effective systems figured out. Here are a couple of examples from farmers in the North Bay Area, shared with permission, that can provide helpful food for thought.

Large-Scale Farm Example:

"We use a growing medium from Wheeler Zamaroni for our starts, then feed them some liquid fish as they get bigger before transplanting. We side dress especially the heavy feeders, and any second crop on the same ground... When our starts come out of the greenhouse to harden off we irrigate them with a liquid fish and seaweed fertilizer. We rely heavily on our cover crop and compost for our initial plantings in spring. For our second succession plantings we typically side dress with a feather meal 12-0-0."

- Annabelle Lenderink & Nick Civetz, Farm Managers, Star Route Farms

Mid-Scale Farm Example:

"Last season we ran into nutrient challenges with our starts, particularly with brassicas in 200-cell trays. Although the potting mix we used had an adequate NPK on paper, the combination of small cell size and potential nutrient lockout led to nitrogen deficiency and weak growth. Through trial and error, we found that supplementing the mix with bat guano and applying a weekly compost tea (with an OMRI-listed fish hydrolysate) greatly improved seedling vigor and reduced transplant shock. We use Bio365 BioAll as our base mix; while more costly, it holds moisture well, produces plugs that work smoothly with our transplanting equipment, and provides sufficient nutrients for lighter-feeding crops without amendments."

- Alex Kuhn, Farm Manager, New Family Farm

Educational Farm Example:

“As mentioned above, there are many commercially available, organically acceptable, seed starting/seedling mixes, but they often lack essential nutrients to support early seedling development. Most of these offer the good texture/structure/drainage/aeration/moisture holding capacity needed to germinate seeds, but their lack of nutrients leaves growers with either the need to come back with supplemental soluble fertilizers like fish products and compost teas shortly after germination through transplanting time, or the need to blend in a balanced, granular and readily available NPK fertilizer prior to planting so as to meet the needs of early seedling development. Both of these processes can be time and labor intensive and can lead to lack of consistency if liquid or granular amendments are not properly portioned and evenly distributed.

After years of making our own mixes from scratch... we ultimately landed on buying an organic seedling mix that came with fertilizer already blended into the mix. We now purchase Sunland Garden Products (now owned by Berger of Canada) "Organic Plug Mix with Fertility SMOP2." We landed on this mix after extensive trials at the UCSC Center for Agroecology Farm Greenhouses, of everything we could get our hands on here on the Central Coast, that might meet our needs, comparing a range of mixes with and without existing fertility straight out of the bag/tote. For the mixes that did not come with any fertilizer, we also assessed the time it took us to blend in compost and or granular fertilizers, versus applying liquid fish/kelp after germination, versus not having to do so with mixes that included a pre blended fertility source.

In the end, we landed on the Sunland Organic Plug Mix because in our trials, we found that this mix produced the highest quality transplants, at the lowest cost per seedling, and did not require the additional labor of blending in fertilizers or applying liquid fertilizers, and we are acutely aware of the huge demands for a finite labor supply on farms. While the Sunland may not be available in Sonoma/Marin/Napa counties, perhaps Berger distributes their OM2 organic seedling mix (which has fertilizer included) through one of the suppliers in your area. I have not actually used this mix, but if it is similar to their Sunland Organic Plug Mix with Fertility SMOP2, then I imagine it could be a good resource for your growers. For anyone making their own mixes or wanting to blend a fertilizer into nutrient free substrate, I recommend trialing PAR4 9-3-7, from Bridgewell. This is the fertilizer that is in the Sunland Mix we use, and we have found it also works well in other mixes.

No matter the scale your growers are working, I encourage everyone to run their own in-house trials of soil mixes they are considering, both your own recipes and mixes that can be purchased locally. Being able to see how different mixes perform side by side, under the same growing conditions is vital for making an informed decision about what mix to use to produce the highest quality transplants. One page 8 of the [publication](#) linked above, there is a description of how to conduct a Soil Mix Assay, or small scale soil mix trial. Unfortunately, in the transition to our new website, it appears that the url for the Soil Mix Assay observations template was lost, but it would be easy enough for anyone interested to create their own observation template. In the assay description, it suggests using broccoli, cress and wheat because these all readily show signs of nutrient stress, but really I think people should trial whatever crops they grow the most of, or that they have the biggest challenges with so that they are landing on a mix that best meets the needs of the biggest swath of their seedling production.”

-Christof Bernau, Farm Garden Manager, UCSC Student Farm

Small-Scale Farm Example:

“I've been using soil blocks for just over a year now and so far I am really liking them. I find that they produce more vigorous starts which are faster to transplant out than cell trays and are less stressed after getting in the ground. The blocks retain moisture better, while hydrating faster and with more uniformity. The tools that make the blocks are metal and will last forever, unlike plastic cell trays which crack, tear, and degrade in the sun. Getting the potting mix just right is the key to success with it all. You want soil that will hold its form after being created, but is still light enough for root growth and proper water infiltration. While there are many potting mixes out there which are sometimes ready-made for blocking, they are often expensive and not organic. Here at the Occidental Arts and Ecology Center we are certified organic so we have certain restraints which you might not have. That said, we have found that making our own mix is how we are able to have the highest quality and consistent organic mix which isn't too expensive.

Here's our recipe:

- * 5 gallon bucket coco coir (I use the Down to Earth 12kg bale as it is OMRI listed, but I would love to find a more local source as this comes from Sri Lanka)*
- * 5 gallon bucket perlite*
- * 5 gallon bucket compost (We use a food waste composter which we have on site, but most compost should work as long as it isn't hot, have seeds, or too woody)*

** 1lb organic powder amendment (I use the 4-6-2 from E.B Stone or Down to Earth)*

We mix this all up in a wheelbarrow with water until it is fully saturated (think oatmeal consistency) but water should not pool much at the bottom. Once fully homogeneous, you are ready to make blocks and sow into them as you would any other cell tray. For heavier feeding crops I sometimes mix in extra powder amendment, but more often I will give them a dusting as they come out of the greenhouse. We use the soil blockers from Ladbroke, but there are several other options on the market which may better suit the needs of your operation (the blockers from Swift Blocker look like a great design). I currently have 3 different sizes of the stand up blockers from Ladbroke: Multi-35, Multi-20, and Multi-12. Many people form the blocks into 1020 trays, but I have an abundance of old speedling trays which can perfectly hold 6 sets of blocks. You can really put your blocks on any flat surface.

We do not use vacuum seeders, but if you do, they won't work with the Ladbroke blockers as the cells don't line up well enough in a 1020. Vacuum seeding may work with the Swift Blocker products however as they make them in more standard sizes (50, 72, 128, 200 cell options). Although this method is somewhat niche and differs from what many growers typically do, I hope you find this information useful."

- Miles Horobin, Farm Manager, Occidental Arts & Ecology Center

Home Garden Example

"I've been asked to share some of the methods I use in managing fertility in my transplants, potting mix and seed bedding. For me it all begins with a good quality thermophilic and worm compost, both of which I produce onsite. I put through a 1/4 inch screen 2 parts finished hot compost with 1 part worm compost, mixed together with small amounts granular kelp, azomite and neem seed meal. I then add ten percent of this mixture to my preferred potting soil for seeding in cell trays. For transplanting seedlings I put some of this mixture into the planting hole, along with a sprinkle of mycorrhizal fungi, then water with a solution made up of a bio-stimulant called Effective Microorganism (EM), fish hydrolysate and humic acid. I've had very good results with this blend so far, and when the compost tea, which is made onsite twice a month, is available, I use that instead."

-Jon Brzycki, First Fruits Homestead, Napa

