The Three Sisters Garden

48th Daa Agriculture and Nutrition Fair

Instructor Jeff Warner

PPT compiled by Donald DeLano

This class is to familiarize you with the ‘Three Sisters’ growing method utilized by many Native American tribes for a more successful way of growing these three crops: corn, beans, and squash.

What we hope to accomplish through this class is to enable you and your students to plan out and develop your garden based on the Three Sisters concept and to be able to do some harvesting before classes end for the school year.

Careful planning has gone into the selection of materials that you will receive if you are in this class and have registered to compete in the 48th DAA 2024 School Garden competition. This will introduce you to the growing kit, its parts, and how to use them to germinate and care for the young seedlings. Then how and when to transplant them to your garden at the correct times, getting a head start on growing your garden.

The actual classroom lesson plan is available online through the 48th DAA Agriculture and Nutrition Fair website.

The kit contains seeds of the following for the Three Sisters Garden: Signature, a form of sweet corn, Carminat, a vining bean, and Spinless Perfection, a selection of zucchini squash.

It also contains the following seeds: Nelson French Breakfast Radish, Easter Egg Radish, Touchstone Gold Beet, and Chioggia Guardsmark Beet. We have included these easy-to-grow and quick-to-harvest direct sow seeds to help keep your students interested in the harvest, providing things to do as they await the main harvest of the Three Sisters. They will be a stepping-stone to taste enjoyment.

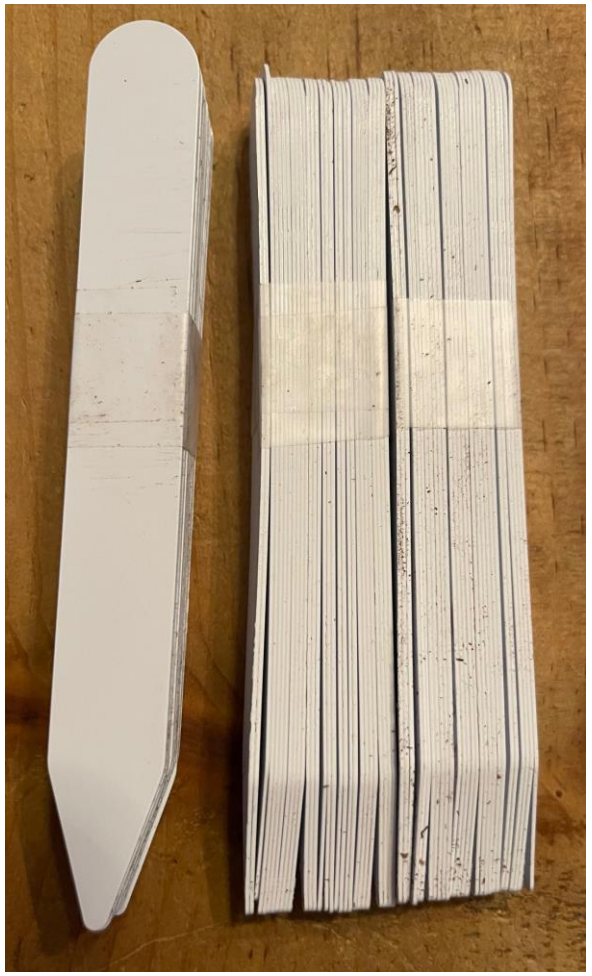
The Kit includes a growing chamber for seed germination, two types of plant labels, an LED lighting source with timing controls, expandable Jiffy Peat Pellets, seed, and a multipurpose organic fertilizer.

This extra tall seed germination and cutting growing chamber is very durable and should hold up through many growing seasons.

The tray is leakproof

The clear plastic top makes for a nice seal

Has two separate adjustable vents on top for humidity control

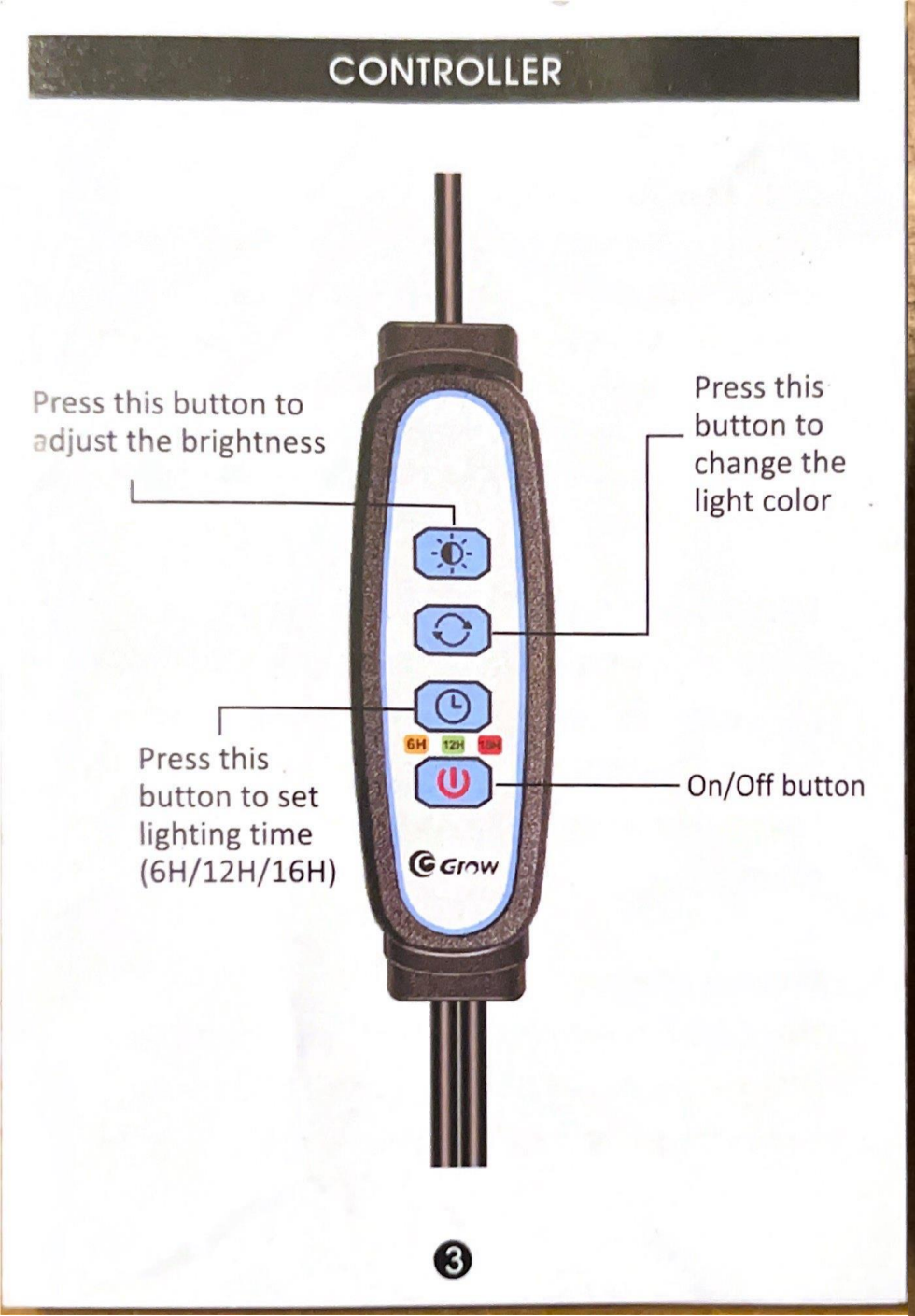


The white five-inch plastic tags are easy to write on with a #2 pencil and can be reused by erasing with a standard pencil eraser.

The twelve-inch non-lead-based painted high visibility wooden tags will last the season in the garden.

The LED light is a clamp-on double gooseneck unit with a built-in timing controller that adjusts the light levels and type of light output

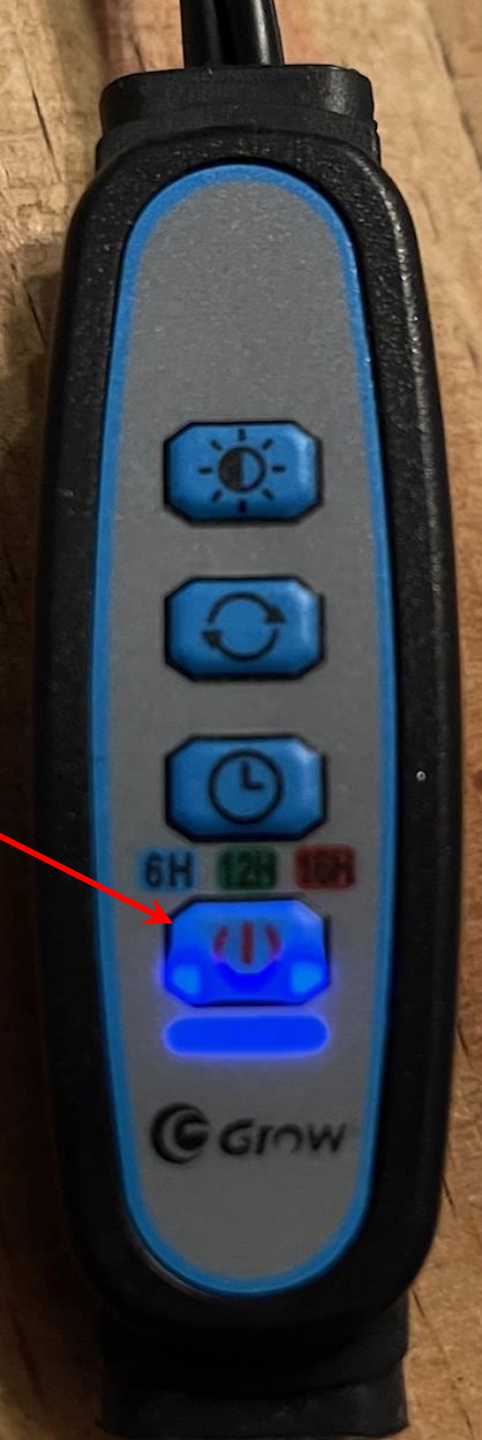
The USB power adapter sometimes comes wrapped in a hard-to-see protective plastic wrapping. Please remove this before use.



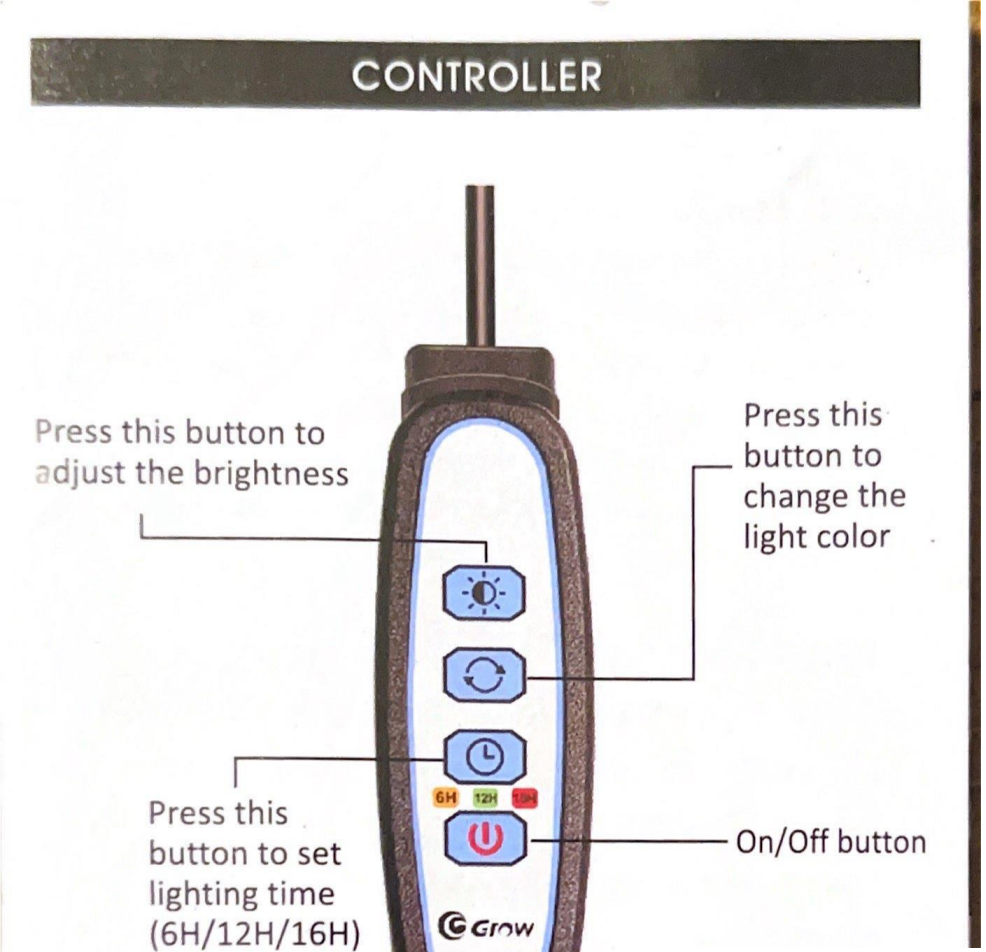
To the left: actual controller.

To the right, the light unit is plugged in but not turned on. Note that the on button will light up if it has power.

When the lights are turned on, this button will change colors depending on how it is set.

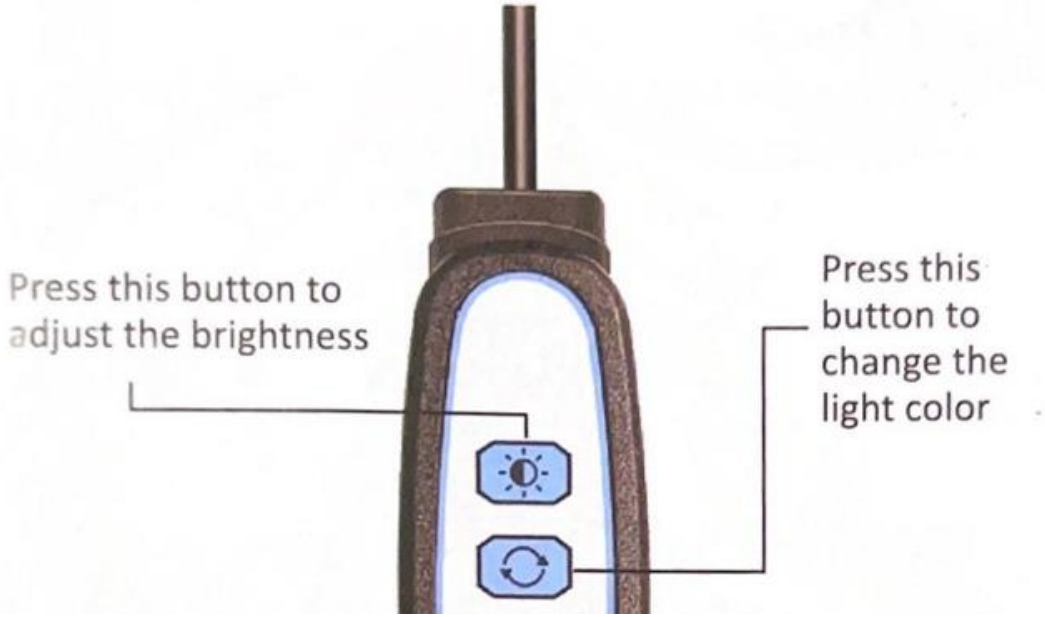


CONTROLLER



When setting the timer, push the clock button. It will light up a different color: blue for 6 hours, green for 12 hours, red for 16 hours.

The lights have 3 settings that let you adjust the type of light the seeds receive. Just white, a mix of red and blue, and a mix of all three. This is the level you should be using. It will provide the light levels which compare best to the full sun and give the best growth.



They also have 5 settings that change the intensity of light. Use the brightest setting to emulate the full sun.

When using the chamber with the LED lights, position them equally spaced laying directly on top of the plastic chamber’s top.

There is no danger of them overheating and will provide the most light for proper seedling growth to keep them from stretching.

If your chamber is almost full across the bottom with seedlings, run the lights lengthwise on top. This will provide the best balance of light to all the seedlings.

If you only have a portion of the chamber filled with seedlings, it is best to position the LED lights sideways on top equally spaced over the seedlings to provide the best lighting.

Do not, as in this picture, place the lights over the air vents as it will reduce light to the seedlings below.

Please note

The timer sets the number of hours to run based on the time of day that you turn on the light and set how many hours to run. If you turn the light on at 3 pm, then push the button for 12 hours, the lights will come on every day at 3 pm and go off at 3 am. You can change this by turning the light off, then turning it back on, and pushing the timer button to the desired setting. If you have a power outage, you will need to turn the light back on and then push the timer button again. Losing power resets the unit back to off and clears memory.

For the germination of most seeds, you should set it to run 12 hours per day.

There are many acceptable ways and soil media to germinate seeds. We have chosen to supply Jiffy Peat Pellets. They are clean and easy to handle in the classroom without the use of additional plastic materials. Each kit has approximately 75 pellets. For further use of this setup when you run out, they are easily available on Amazon, or cheaper by the box at Greenhousemegasstore.com, or other online horticulture sources. You can also use bagged potting mix. We recommend something like Miracle Grow's Seeding mix (a combination of peat moss, coir, and perlite - not their outdoor potting or planting mixes), coir (coconut husk fibers), or Glee potting mix (structured/engineered wood fibers, not shavings or chipped wood).

Miracle Grow's Seeding mix, expanded coir, or expanded Glee can all be used to start seeds successfully for most plants. The mix needs to be put into some sort of container to hold its shape for sowing your seeds and then transplanting your seedlings without causing excessive root shock. The use of cardboard toilet paper or paper towel rolls, when cut into the proper length, works great.

The website Rockinwhomestead.com has numerous other ideas for repurposed containers to start seeds.

Small circular hole depressions indicate top of the dry pellet.

Pellets have expanded up after sitting in water for 5-15 minutes.

Right side up

upside down

The hole is still easy to see.

Seeds will be pushed into the hole.

A pencil makes a good tool.

The Jiffy pellets come in various sizes and components. The ones we have provided are peat moss and are of the shortest expansion height to contain the plants inside the growth chamber. They also come in a mix of peat and coir, or pure coir, and can be of various sizes, all the way up to 5” tall. Most can be ordered with various levels of nutrients added. Some people suggest the removal of the netting at planting out, others do not.

Signature Sweet Corn is harvested 72 days from germination. Corn is wind-pollinated, so it must be planted into a block pattern to ensure a good harvest. This means clusters of plants where wind can blow into the grouping, spreading pollen through the plants. Planting in a single row results in a poor ear set. Planting in 3 or more rows or planting in circular groups of 3 concentric rings that are spaced 12”-18” apart can accomplish this goal.

Corn does not germinate well if soil temperatures are below 60^{o}F. To get an early crop, the seed can be germinated inside with the proper conditions, then transplanted out after 2 weeks at the 2nd or 3rd leaf stage. The young plants can tolerate temperatures in the low 40s with no damage, just slowed growth. They will need to be fed just after germination, then again when transplanted into the garden, then again in another 3-4 weeks.

Carminat Bean can provide its first harvest around 60 days when the pods are 7”-9” long. Their purple color is unique and can be eaten fresh or turn a more normal shade of green when cooked. They are a pole bean, requiring some sort of support for growth. they will not germinate below 60ºF. Once germinated, they can tolerate to the low 40’s. Some beans are bush, others pole, or vining. Carminate is a pole bean and will need support.

Beans are a legume. All legumes can develop a symbiotic relationship with a certain nitrogen-fixing bacteria. To simplify: legumes form a protective pocket-like nodule where these bacteria can thrive. The bacteria benefit by colonizing these nodules, absorbing excess carbohydrates from the plant’s cells. In turn, absorbing free nitrogen from the air and ‘fixing’ it to a form usable by the plant, and some surrounding plants.

The beans use the corn stocks as a form of support. This requires the corn to be planted a few weeks before the beans so they can be taller, or the beans can overgrow and tangle up the corn, suppressing growth.

Spineless Perfection Zucchini Squash can have its first fruit harvest in 45 days, and blossoms in 35 days from germination. Zucchini has some of the earliest harvests of all squash or pumpkins. Spineless has almost no prickles on its leaves and stems, allowing easier harvest and less chance of getting scraped. Most squash will not germinate below 65^{o} F, but the foliage can tolerate temperatures in the low 40's and fruit in the low 50's.

Squash and pumpkins produce large leaves, which aid in shading the soil around the corn and beans, preventing the growth of numerous weeds. This variety is considered a 'clumping' type, taking up less space in the garden, which is good for those with minimal space to use. Most other squash and pumpkins can produce vines that can grow 5'-30' or more in length. Take this into consideration with future garden selections. Just of interest to those wishing to plant pumpkins in a small area, consider the variety 'Igor'. It is a clumping form with a spread of 5'-6' in diameter, but still producing 25-35 lb. jack-o-lanterns. They take 100 days to harvest from germination. If planting for Halloween, the seed should be sown sometime between the end of June and the first two weeks of July.

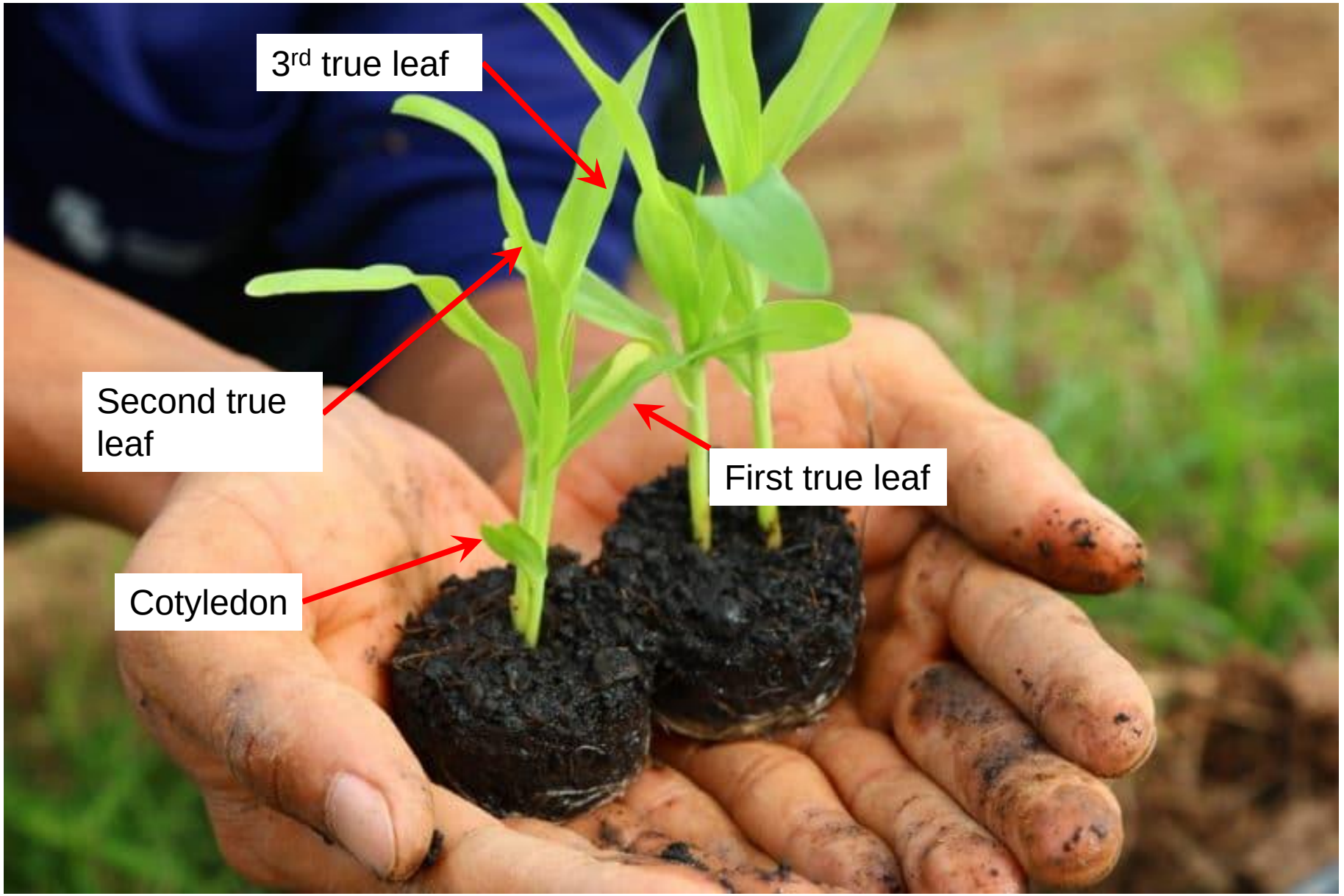
Corn seedlings in Jiffy plugs with the netting removed ready to plant.

When to plant out depends on their growth and development.

Cotyledon – the baby seed leaf (only one in grasses/monocots.

Plant the seeds about ½” deep in the Jiffy plug, pushing them in sideways, narrow side up.

Transplant at 2nd to 3rd true leaf stage.

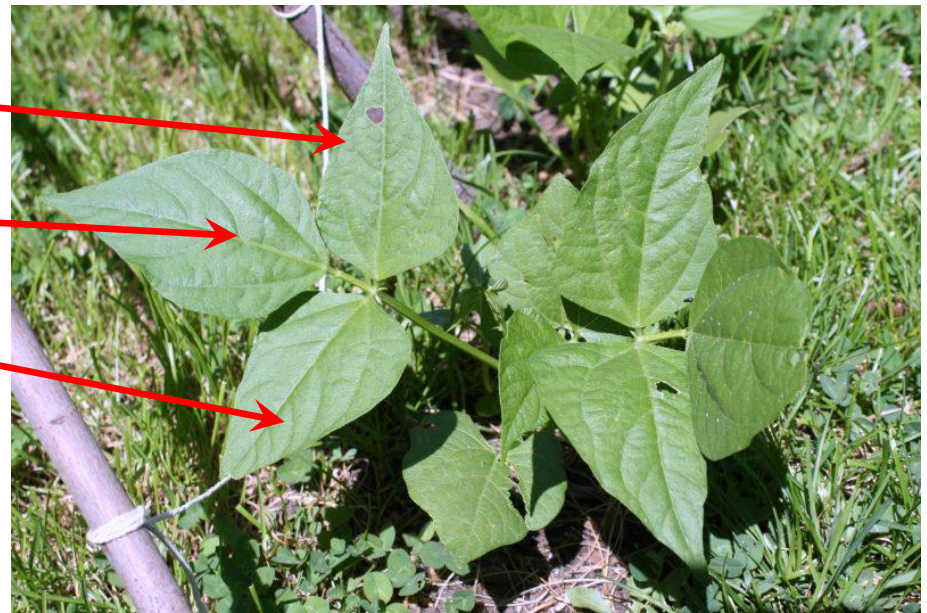


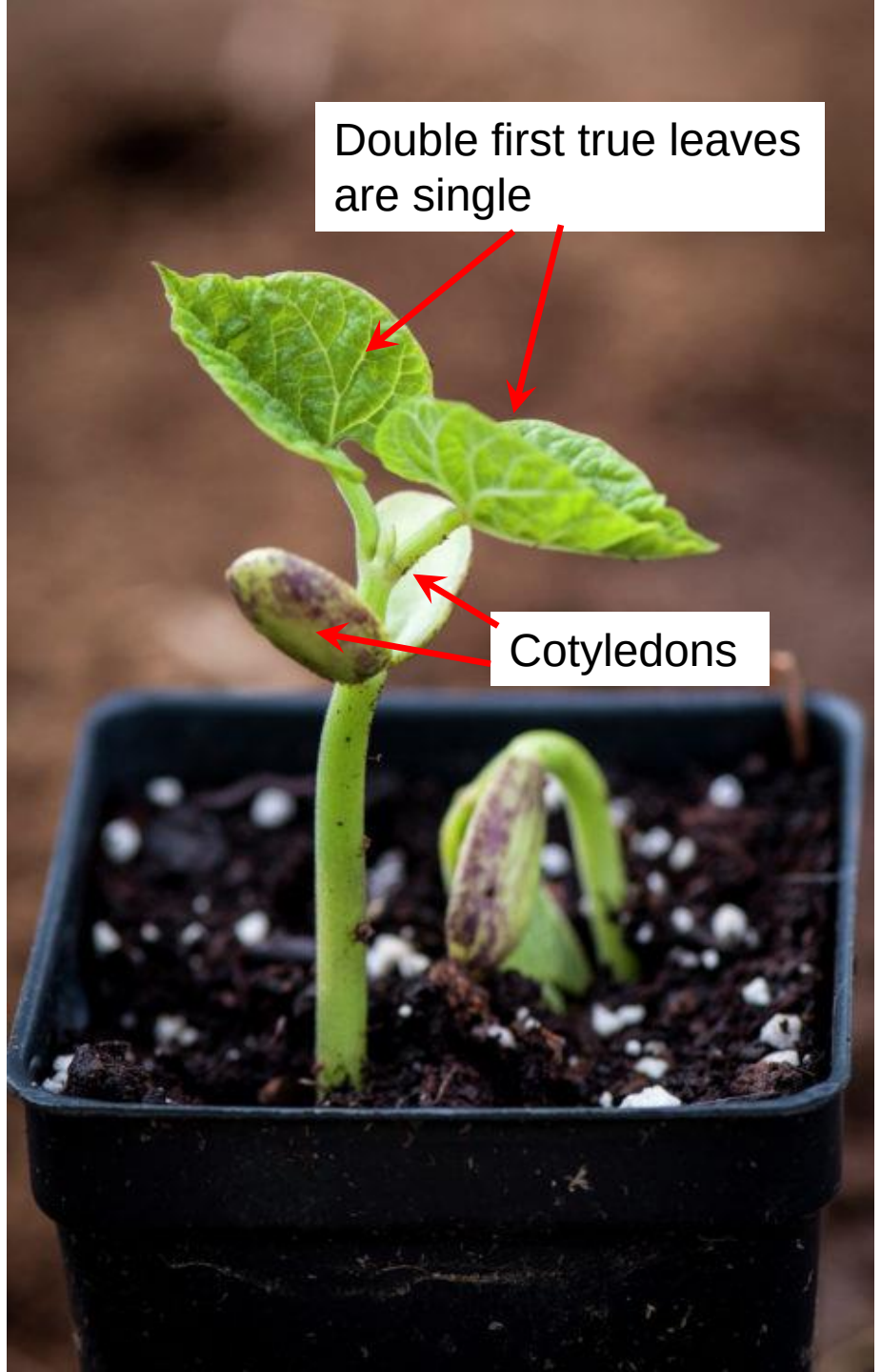
When germinating, the seedling bends up, releasing the emerging growth from the soil mix. As it stretches up, the fat cotyledons have stored nutrients to help the young seedling become established. Plant the beans about ½ way down in the Jiffy pot with the seed vertical.

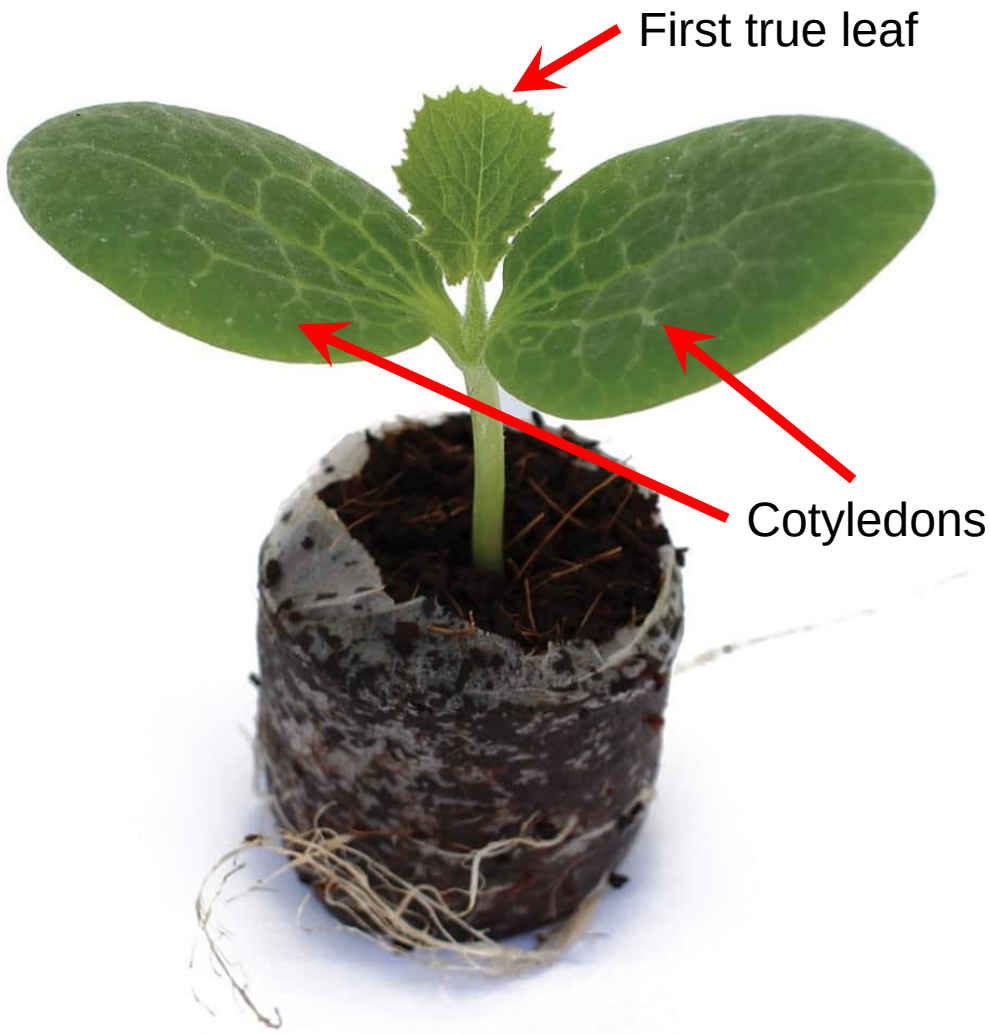
As the true leaves emerge, the stem will continue to elongate into a tendril that will need to wrap around something soon.

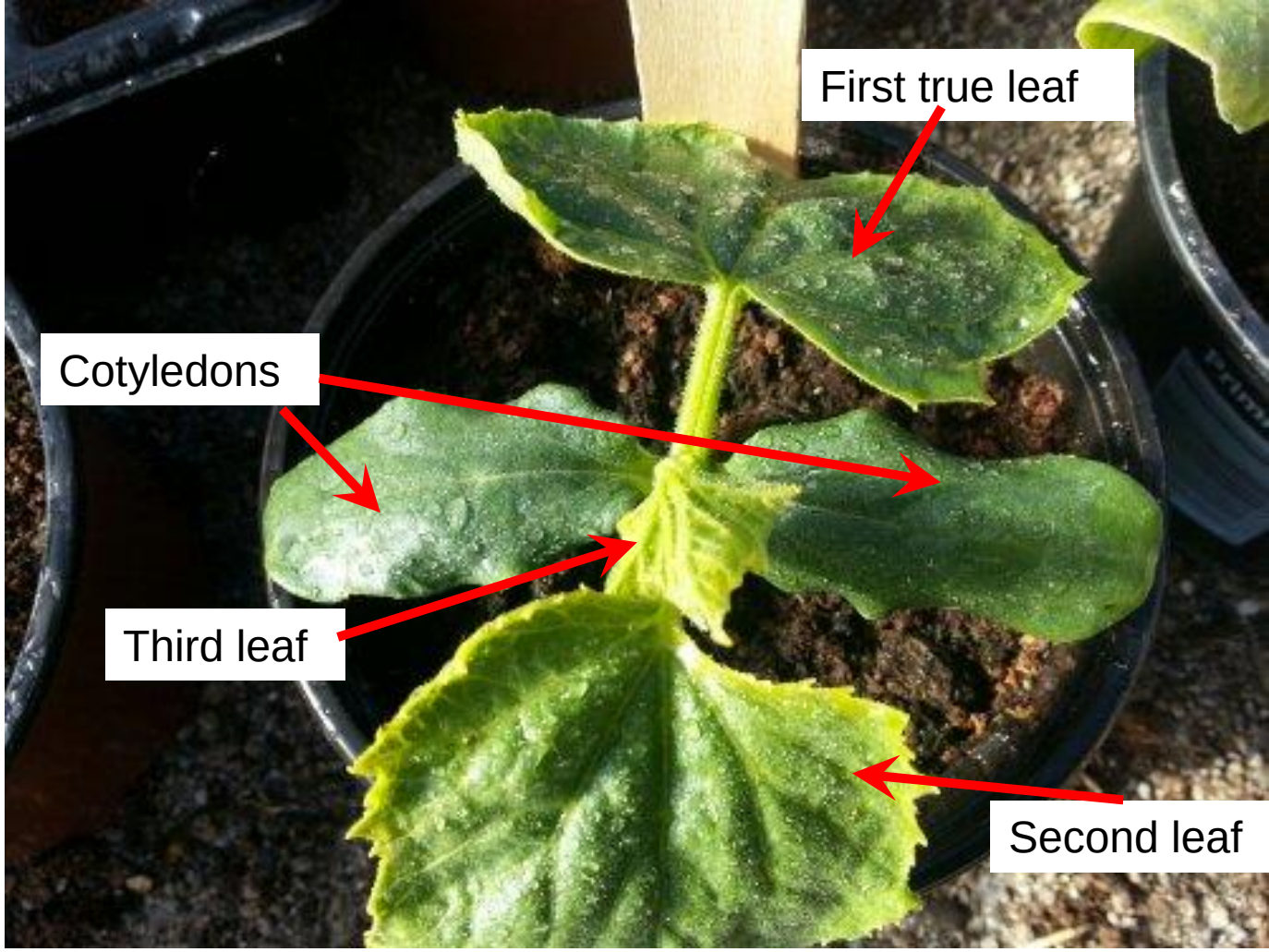
Transplant out when the two true leaves have emerged, and the next set is developing. Many beans have opposite leaves, producing two leaves at a time. The first set of true leaves will be single, the next set will be a compound leaf of 3 segments. Transplant when the second set of true leaves emerge

The second set of true leaves will be compounded in 3 segments









To the left, an emerging squash seedling. The two thick cotyledons have expanded but are still providing nutrients to the young plant. The first true leaf is expanding out. To the right, you can see two developed true leaves and a third just emerging. It is best to plant the squash seeds on their sides about ½ way into the Jiffy plug. As seedling emerges and the cotyledons expand, they will push off the old seed coat.

Transplant when second or third true leaf emerges.

We have included G&B Organic all-purpose fertilizer in the kits to ensure proper nutrition for the growing plants.

It was common for Native Americans to incorporate items left over from their diet, including bones, feathers, and rotted seaweed (from coastal tribes) among other items into their planting areas.

These materials, as they degraded over time, supplied necessary nutrients for the growing plants, such as phosphorus, potassium, calcium, and more.

Archeological research into farming development worldwide notes most cultures developed methods to benefit plant growth and increase crops. Selecting the best plants to grow the next crops, to companion plantings that appeared to benefit their crops.

Being aware of their surroundings and how plants grew, from manure droppings of animals to seedlings sprouting and growing nicely in kitchen-midden piles have all played a role in forming the agriculture we know today.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Prepping the garden before planting

First and foremost, make sure the garden is clean and as weed-free as possible. Other ways to prepare include adding aged compost or aged ground wood products. Do not add wood chips that have not been composted when you are planting. When they decay, they will rob your growing plants of nutrients. You can use wood chips as a top cover but use them sparingly if they are not composted to break them down.

A few days before planting your corn, you can broadcast the fertilizer, then incorporate to a depth of 4”-5”. To broadcast, in a garden that is 5’ wide by 10’ long, use 5 cups of this fertilizer evenly spread over the area. It is used at a rate of 1 cup per 10 square feet.

If you decide not to broadcast before planting, have each student dig a small hole, then at the bottom, place one level teaspoon of fertilizer per plant plug. Cover with about ½”-1” of soil, then place the plant in the hole, cover the root system/plug, press lightly, then water in when everyone is finished.

Repeat this with each successive planting.

You might need to add additional fertilizer once more in a few weeks as a side-row dressing to keep growth up until the bacteria start to convert nitrogen. This can also provide more calcium for the developing plants.

G&B Organic Fertilizer is rated 4-4-4. This means it has equal parts nitrogen, phosphorus, and potassium. Even though the beans will help supply nitrogen to the plants, it will take a while for this to occur. A couple of applications will ensure the proper growth while supplying potassium, phosphorus, calcium, sulfur, and other nutrients the plants will need that may be depleted in your garden. It also keeps you from having to add dried kelp, fish bones, animal manure, and other items that were used to supply these key ingredients.

The fertilizer is made up of Alfalfa Meal, Bone Meal, Feather Meal, Dehydrated Manure, Kelp Meal, Humic Acid (material left over from decayed and composted materials), Potassium Sulfate (a naturally occurring form of potassium and sulfur, both necessary for proper plant growth), beneficial microbes and bacteria inoculants to help the soil develop and become more sustainable.

There are many ways to apply this fertilizer to the garden: broadcast incorporation, side dressing, and as a liquid. tea.

Broadcast

Adding nutrients to the top of your potting mix or garden before planting, then mix in thoroughly, or to a depth of 4-6” in the garden. Some prefer to make a homogenous mix, adding the nutrients to the potting mix and thoroughly incorporating, then filling the containers.

Top or side dressing

Side dressing is used in field crops. A 2-3” trench is dug along alongside the plant row, then fertilizer is sprinkled into the trench then lightly covered back up. Top dressing is used on plants that are spaced farther apart or in containers, then slightly cultivated in.

Organic Fertilizer Tea

Most organic fertilizers can be made into an easy-to-use liquid fertilizer tea. You need an appropriate container that will not spill, a measuring cup or spoons depending on how much you are going to make at a time, and a fine strainer.

1. For 1 gallon you will need 1 cup of 4-4-4 fertilizer. For one quart, you will need 4 tablespoons of fertilizer.
2. Mix fertilizer into the water, and stir, letting this solution sit for 24-48 hours uncovered. It does have an organic odor.
3. Strain material if feeding your seedlings in the tray. You do not need to strain if pouring into the garden. The materials you strain out can be tossed into your garden.
4. Use a cup, spoon, or turkey baster to water your seedlings. Turkey basters are easier.

Each plug would get about 1 teaspoon of the liquid squirted onto the plant and plug. After about 2-3 hours, use the turkey baster to remove any excess liquid sitting in the bottom of the tray unless you think it will be absorbed in 24 hours. You do not want the roots sitting in water longer than that.

You should start feeding all seedlings as soon as they start to emerge from the peat plug. Feed weekly until transplanted out. A starving seedling will not produce a good plant and you cannot make up the loss. This is very important to a successful crop.

A tentative planting schedule

Week of February 26: sow corn seed in Jiffy plugs. If below 55 degrees will take 18-21 days to sprout. If 60^{o} F or more, 8-10 days to sprout. The temperature in the classroom will affect germination and planting. Will be ready to plant out about 10 days after germination.

Weeks of March 11-18: corn should be ready to plant in the garden somewhere in this time block. (2 ½-3weeks).

Weeks of March 11-18 when the chamber is empty, plant beans. If above 60^{o} F, they should germinate in 4-6 days, and be ready to transplant out in another 10-14 days. (2-2 ½ weeks).

Weeks of March 25 – April 1, transplant beans.

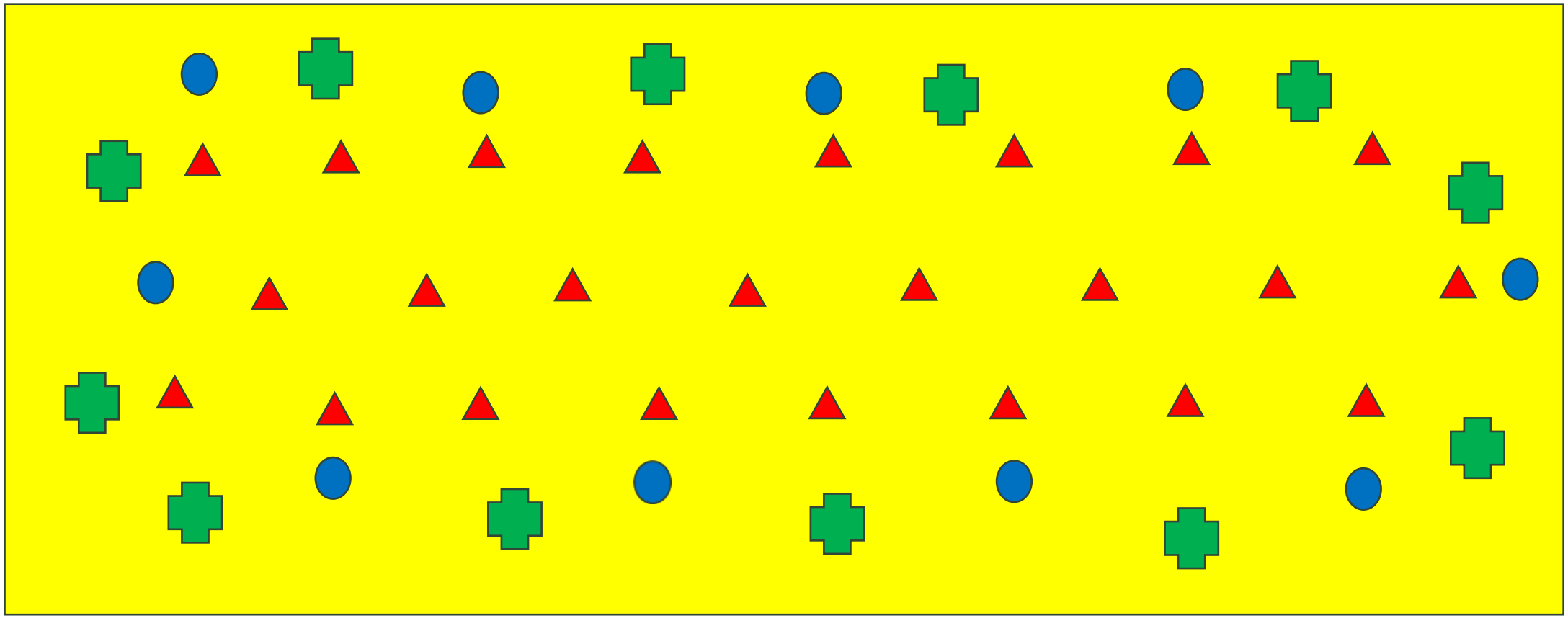
Weeks of March 25 – April 1, plant zucchini squash. They will germinate in 7-12 days and be ready to transplant out in 10 more days if temperatures are above 65 degrees in the classroom. (2 ½-3 weeks).

If you are planting a smaller garden, plant corn first, then when the germination chamber is empty, you can sow both beans and squash at the same time to get a head start.

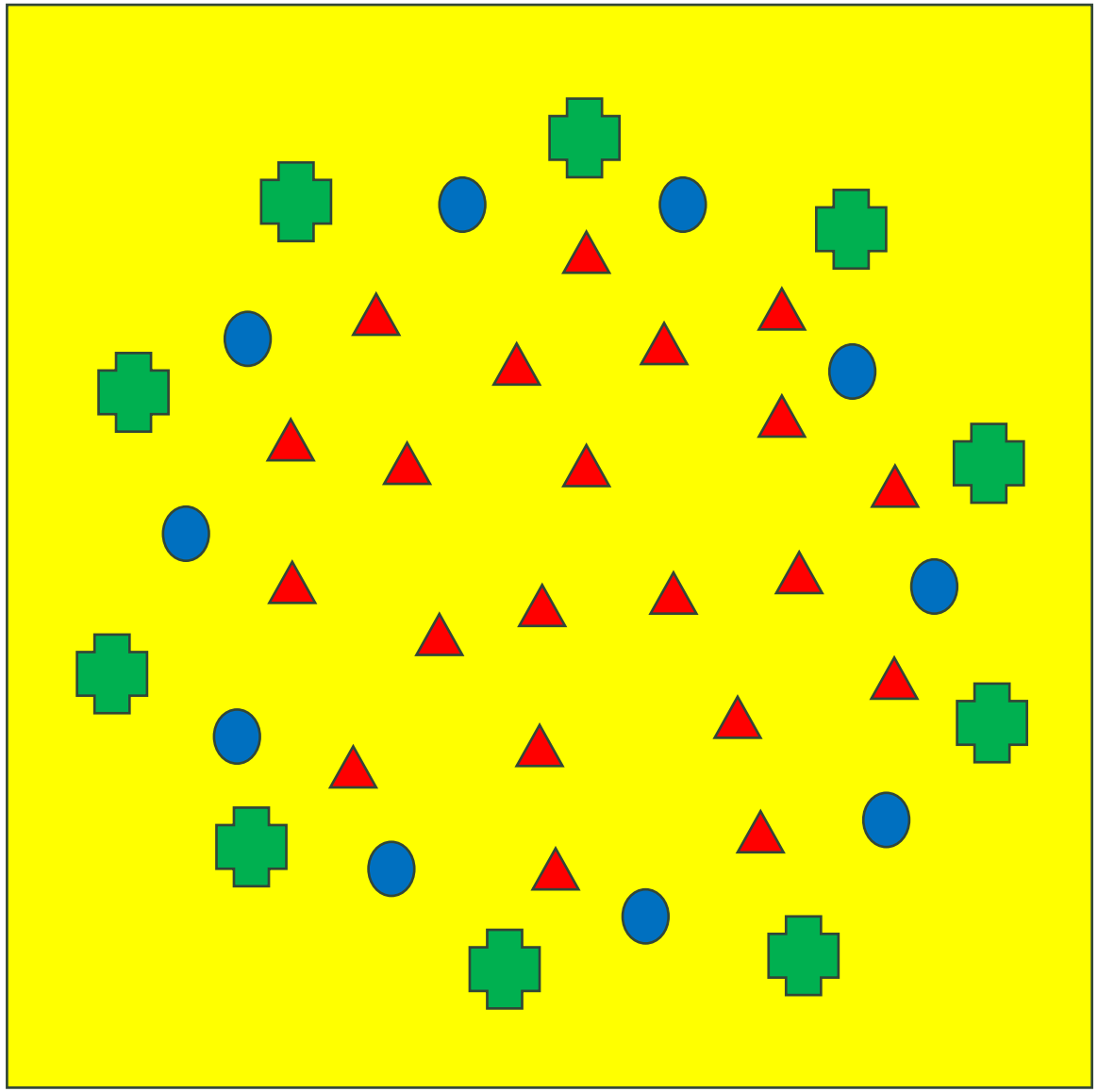
The sooner the seed gets started, the better the chance of having a harvest before the end of the school year.

Suggested planting plan for best pollination of corn rectangular garden space

Green = zucchini
Blue = beans
Red = corn



In a round container of square foot garden



Green = zucchini
Blue = beans
Red = corn

Planting in patterns like these two samples provides the best chances of wind pollination for corn.

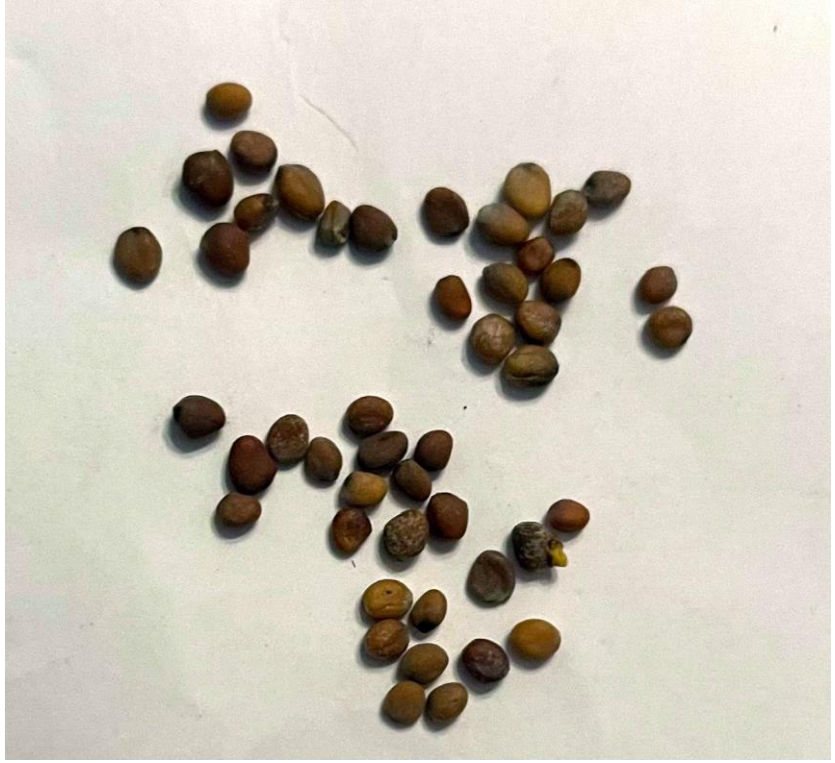
You should space the corn about 12” apart, with the beans planted about 4”-6” from the corn to allow its tendrils to grab onto the corn and vine up.

The squash should be planted about 12” – 20” out from the corn or beans, and about 2-3’ from each other to eliminate overcrowding.

Depending on the size of your garden, this will indicate how many seeds to plant.

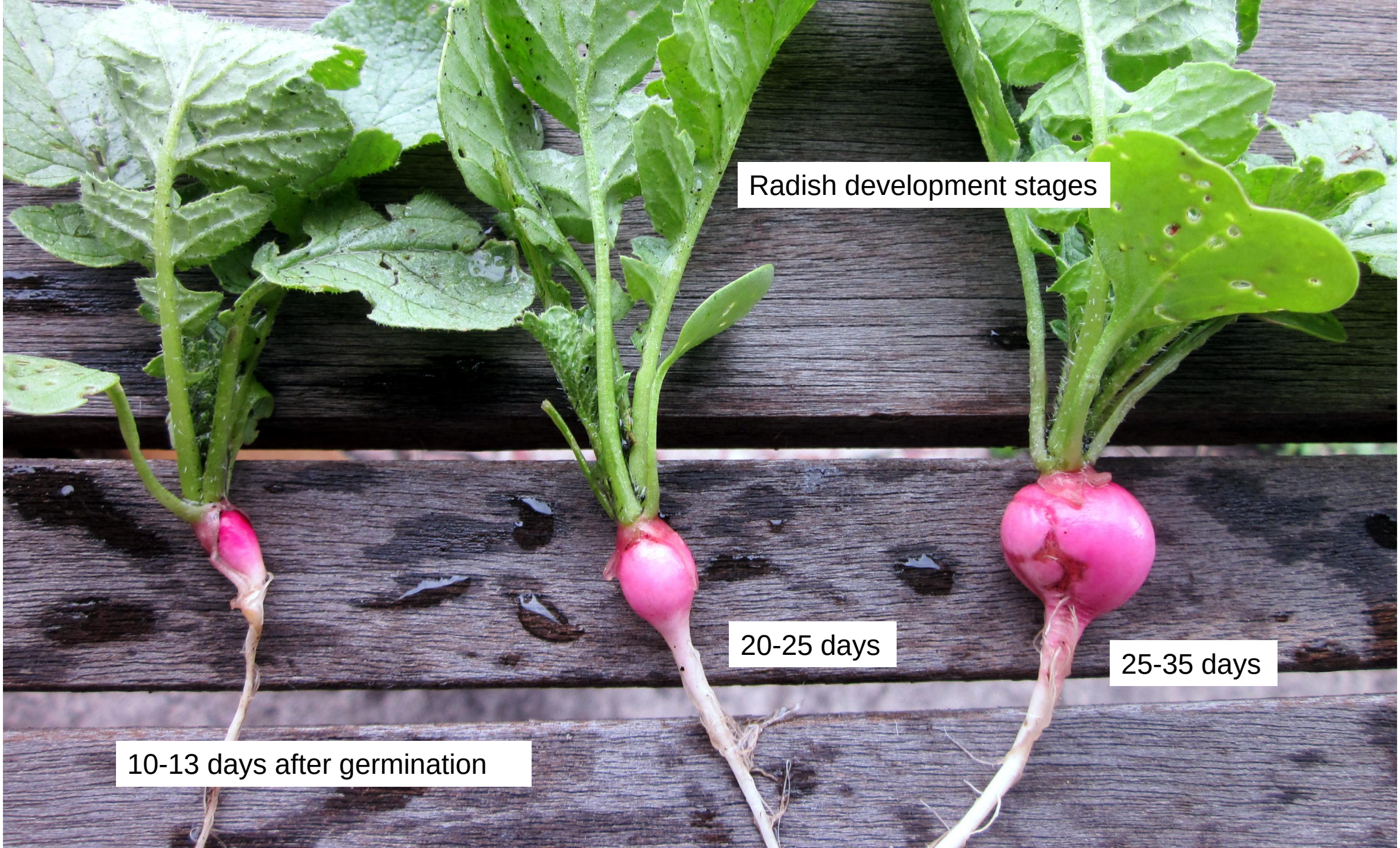
Now for the Beets and Radishes

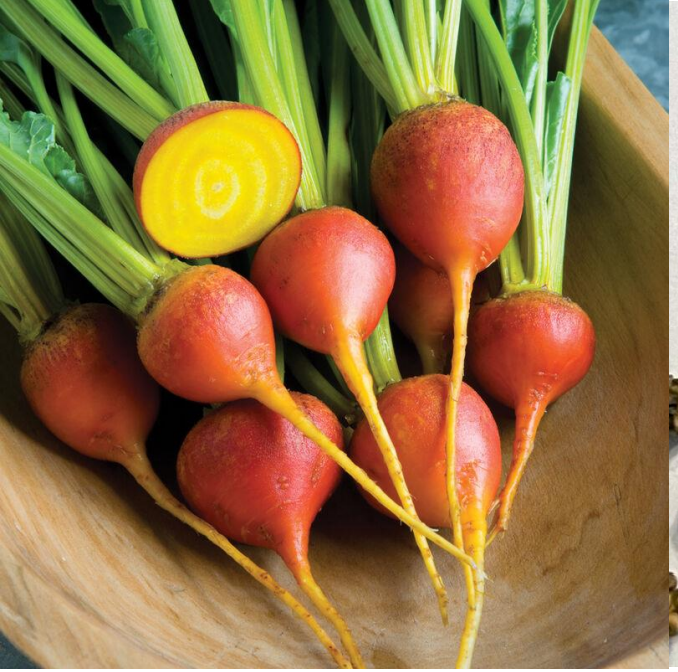
Due to the fast germination and growth of radishes and beets, their cold tolerance, and their ability to survive in the face of adversity, they make a great first impression on first-time gardeners. Fast satisfaction and reward. Planted too deep, but less than 1”, they just take a bit longer to germinate. They do not get enough water and not enough fertilizer you just harvest smaller beets and radishes. They are tough!



Top left: Nelson French Breakfast Radish are fast germination-to-harvest, in as little as 20 days. A traditional French radish, they are commonly sliced lengthwise and served on top of warmed, buttered French bread. Top right: Easter Egg Radish, 30 days from germination to harvest. They are a formulated mix of early, round radishes that are fun to harvest, as you do not know what to expect until you pull.

Most radish seed looks the same: small and rounded. They are best sown directly into the garden in as much sun as possible, or in an outdoor raised planter or container that is at least 5” deep allowing the development of the root system into the radish we eat (other varieties can grow to 12” or more, so allow sufficient depth). They will germinate even with temperatures in the high 30’s to low 40’s F. They should be buried about ¼” into the soil, and can be planted individually, or sown in a line etched into the garden, then lightly covered, pressed in, then watered in. Side dress about 4-5 days after germination. Do not plant too deep, as that can hinder germination. Do not plant too deep, as that can hinder germination.

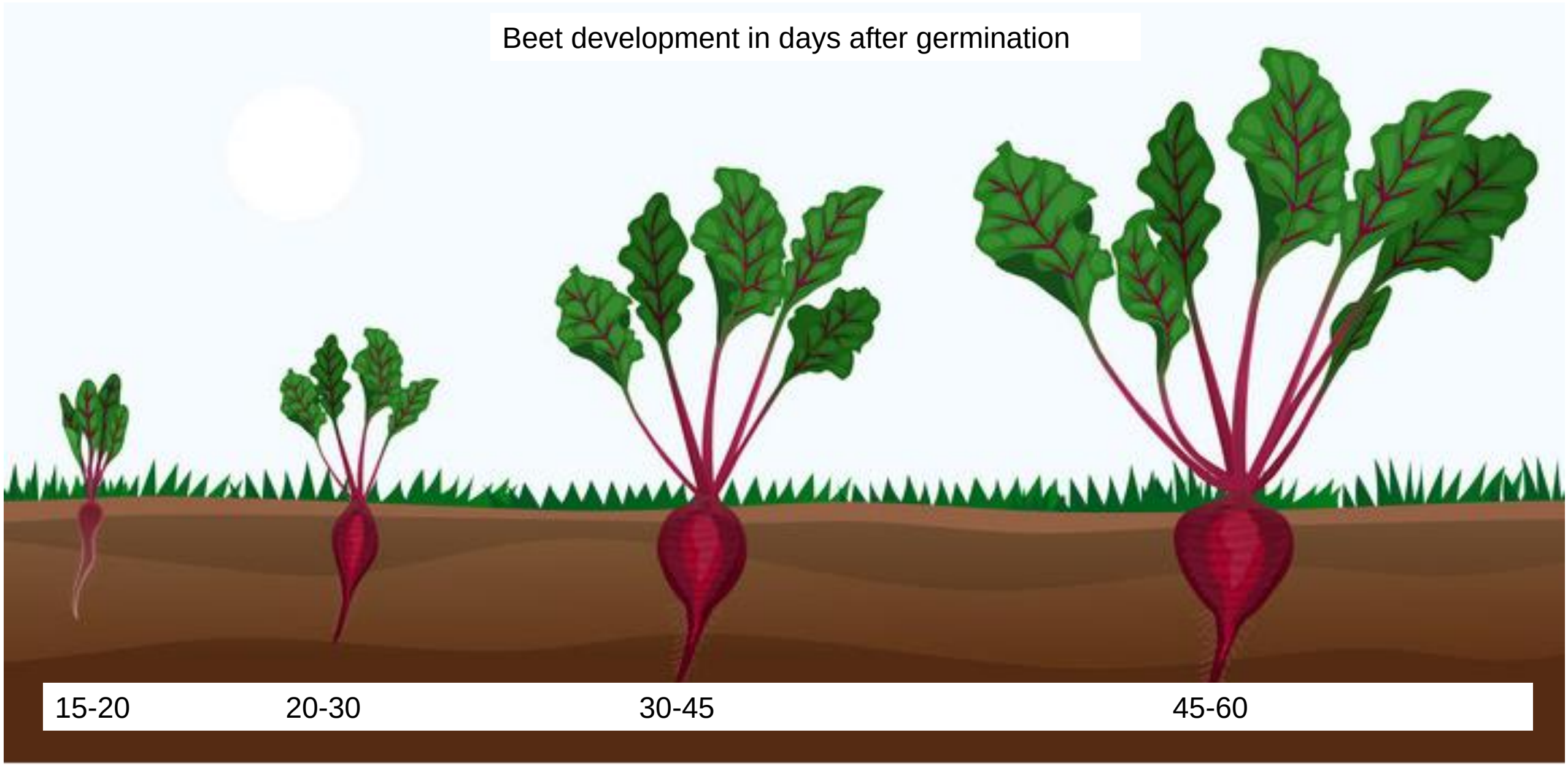

Radish development stages
10-13 days after germination
20-25 days
25-35 days




To the upper left, Touchstone Gold Beets, have seeds that are a pale tan, unlike the darker, almost black seeds of Chioggia Guardsmark, upper right. Beets do something unusual for a seed. Each seed can have multiple embryos inside. This results in planting one seed but having 2 to 5 or sometimes more sprouts develop. Most growers thin to one seed per plant, allowing the beet to grow to a larger, more rounded size. If not thinned, the result can be small, angular, or misshapen beets. Both varieties can be harvested in 30-35 days from germination for baby beets, or up to 55 days from a larger beet.

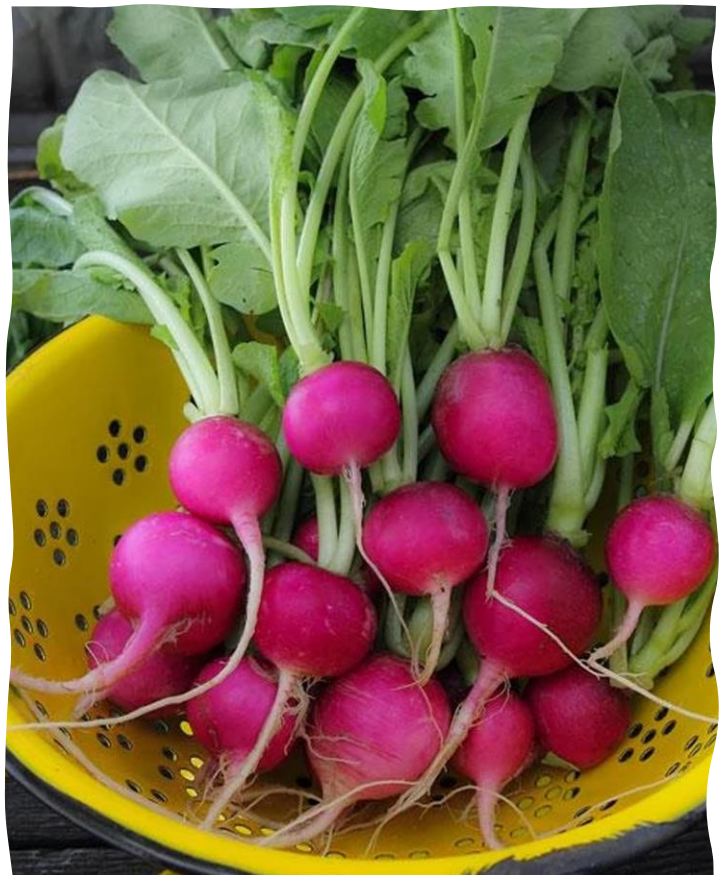
Beets can be started in pots to transplant later, but are best sown directly into the garden, or raised bed, about ¼’ below the soil, the same as for radishes, in as much sun as possible. They also tolerate cooler temperatures during germination. If growing in containers, they should be at least 6” deep. Tamp down, then water in. After germination, they should be fed in about 4-5 days, then again in another 2-3 weeks.

Beet development in days after germination



We suggest your students sow the radish and beet seeds directly outside.

This can get the students into the garden a bit earlier, while the corn has been sown inside the classroom into their Jiffy Peat Plugs.



In a week or two they should be able to see the young seedlings emerge and develop, and within a few weeks will be able to harvest their first crops.

If planted along the edge, the beets and radishes will not interfere with the Three Sisters Garden and will mostly have been harvested by the time the squash starts to cover the ground and expand out.