GROWING VEGETABLE PLANTS FROM SEED UNDER LIGHTS

This procedure works well for onions, leeks, tomatoes, peppers, egg plant, cabbage, cauliflower, broccoli, Brussels sprouts, Chinese cabbage and head lettuce. Peas, spinach, leaf lettuce, beans, beets, carrots, corn, parsnips, potatoes, radishes, Swiss chard and turnips are better off being direct seeded into the garden soil. Cucumbers, pumpkins, melons, and squash do not transplant well unless the root ball is undisturbed when transplanting.

VEGETABLE	PLANT SEEDS	PLANT IN GARDEN
onions & leeks	~Jan 15th	~Apr 15th
cole crops & head lettuce	~Mar 15th	~May 1st
tomatoes, peppers, egg plant	~Mar 20th	~May 20th
cukes, squash, melon, etc	~Apr 20th	~May 20th

Procedure:

1. Buy a **seed starter mix**. Do not use potting soil or garden soil.
2. Select **small containers** in which to start seeds, i.e. margarine containers, plastic tubs, styrofoam cups, plastic seed trays, etc. These must be sterile. 10:1 water to bleach.
3. Fill container will soil mix, make a small hole using the **planting tool**, plant seeds per package instructions, water and label. Use **dial seed sower** for better control of dropping seeds.
4. Place containers inside an air tight atmosphere or use a **humidity dome** and put in a warm place. Use a **heating pad** for tomatoes and peppers and eggplant.
5. When plants begin to emerge in 7-14 days, remove them from the airtight atmosphere, take them off the heating pad and carefully place them under the lights. Use one cool white and one warm white in each **two lamp fixture**, or two cool whites. You don't need "grow lights."
6. When placing under the lights, keep seedlings 1" to 2" from lamps. Use a timer to keep lamps lit about 16 hours per day or longer. If the transplants are growing slow, you can increase the lighting up to 24 hrs/day.
7. Keep evenly watered, do not let the seedlings dry out or get soggy. Grow in a well ventilated area, use a **fan** to circulate air to prevent damp off. Water from below if possible.
8. Ideal growing temperatures are 68-75F during the day and 58-65F at night. Commercial greenhouses tend to use cooler temperatures as then the seeding tend to be stockier.
9. A week or so after the first true leaves appear, re-plant the seedlings into plastic paks. Note: onions and leeks will not be transplanted but remain in original containers. Cucumbers, squash, pumpkins and melons will remain in their pots.
10. Grab seedling by leaves, not stem. Plant them deep in plastic paks. Use a margarine tub of potting soil and plastic spoon to fill the paks, or a ¼ cup measuring cup or your hand.
11. Place plastic paks into sealed flat. Add water to flat and allow paks to soak it up.
12. As seedlings grow, adjust so that they remain 1" to 2" from lamps.
13. Use water soluble fertilizer (1/4 strength) after about two weeks and then every two weeks.
14. Plants should reach transplant size in about 6-8 weeks, 10-12 for onions & leeks and 4-5 weeks for cucumbers, et al.
15. Begin hardening off plants by putting them outside during the day for a few hours and then bringing them back inside at night. Start by just putting them in a shady and wind protected area for a few hours and then work them into the sunlight.
16. Gradually increase the time and direct sunlight the plants get until they can stay outside day and night. This should take 7-14 days.
17. Transplant into your garden; water as needed; protect from frost.
18. Keep a log book in which to record events. wao 03-20

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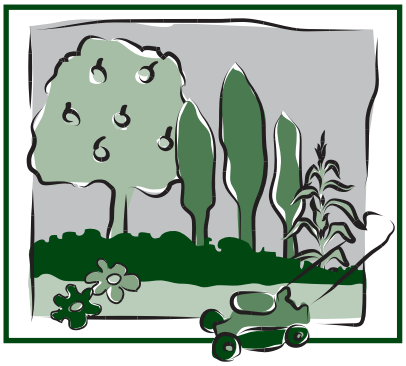

Growing Plants From Seed

Fact Sheet No. **7.409** Gardening Series | **Basics**

by S.E. Newman*

Preparation

Before seeding, spade the garden area 6 to 10 inches deep. Thoroughly mix in coarse peat, compost or aged manure if the soil is too heavy (clay type) or too sandy. Use 3 cubic yards of organic matter per 1,000 square feet or enough to cover to a depth of 1 inch.

The organic matter helps keep the soil from becoming too compact and holds moisture needed for seed germination. Rake the surface smooth and remove or break down clods larger than the size of a pea. Plant seeds in rows and cover with a fine soil to the depth indicated on the seed packet. Mark the seeded rows with identifying labels.

Use good, viable seed. Seed saved from last year's garden rarely results in the flower colors desired because of interbreeding of varieties. Old seed, unless carefully stored in a cool, dry location, often germinates poorly. It is usually more satisfactory to buy fresh, new seed when growing garden annuals and vegetables. Most seed packets are dated using phrases such as 'Packed for (Year)'.

Sow seed directly in the garden for the simplest way to start plants. It is usually safe to sow the seed outdoors when trees are beginning to produce leaves. See Table 1 for when to start seeds of specific plants.

Keep the seedbed moist at all times. When seedlings appear, thin plants to half the height they are supposed to attain, except for tall, spike-like annuals such as snapdragons, larkspur and foxglove. Thin these to one-fourth their mature height for a fuller, more showy effect.

Cold Frames

For an early start, sow seed in a cold frame and transplant it into the garden later (see Figure 1). Seed may be started as much as six weeks earlier than outdoors.

Locate the cold frame on the south side of a garage or dwelling. If built with a tight-fitting lid, the cold frame will hold sufficient heat from the sun to keep seed and seedlings warm at night. On warm, sunny days (50F or warmer), prop the lid open to prevent buildup of excessive heat. Close the lid in the late afternoon to trap enough heat for cold evenings.

If temperatures fall below 20F, an outdoor-type electric light may be placed in the box to produce enough heat to keep plants from freezing. Insulated drop cords are suitable for this purpose. One 60-watt incandescent bulb for every 12 cubic feet of cold frame space usually is sufficient. Electric heating cables are available at most garden supply stores.

As the season progresses, gradually expose the plants to longer periods of outside temperatures, as long as the air temperature does not go below 50F. Treated in this way, they develop into sturdier plants that are better able to adapt to fully-exposed garden conditions at transplant time. This is particularly true of the hardy annuals and biennials that prefer to develop in cooler temperatures: petunia, ageratum, lobelia, verbena, cabbage, broccoli and lettuce. Use Table 1 to determine when to start seed in the cold frame.

Starting Seed Indoors

If space is available near a sunny window, start seeds four to eight weeks before the plant-out date in your area (average date of last killing frost). Starting too early usually results in spindly plants due to crowding and lack of sufficient light.

Almost any container with drainage holes in the bottom will work for planting. Paper milk cartons cut in half, Styrofoam cups, tin cans, plastic trays and pots are common containers used. For convenience, however, you may wish to start plants in the plastic trays and pots available at garden supply centers.

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Quick Facts

- Some annuals are best seeded directly in the garden in spring.
- Cold frames allow starting plants as much as six weeks before planting-out time.
- Do not start plants too soon — they may become crowded and spindly before they can be planted safely outdoors.
- Plants grown early indoors or in cold frames need to be exposed to the outdoors gradually to avoid shock.

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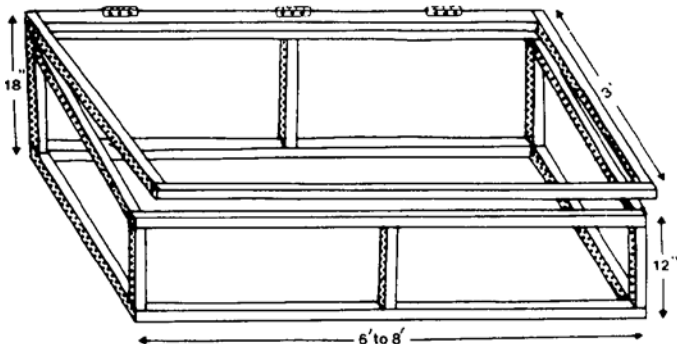

Figure 1: A simple cold frame made with 2-inch x 2-inch lumber. Cover hinged lid and sides with translucent (clear) polyethylene plastic. For better insulation against cold, cover both inside and outside to leave an airspace between layers of plastic. An 8-foot frame requires 10 pieces 2 inches x 2 inches, each 8 feet long.

Use a rich, well-drained soil. Potting soils made for African violets and other house plants usually are suitable and do not have weed seeds. They are, however, more expensive than soil mixes you can make at home. If you use soil from the yard, it should be top soil that is well drained and not high in clay.

The best soils are often found around established shrubs and trees. Add sphagnum peat and sharp sand to the soil in a ratio of about one-half volume of each, and mixed thoroughly.

To kill weed seeds and some damaging soil fungi, place the soil mix in shallow trays or baking pans in an oven for 45 minutes at 250 degrees. For best results, the soil should be moist.

After the soil has cooled, fill containers firmly but do not pack. Allow about 3/4 inch from the soil surface to the rim of the container. Place seeds on the soil surface. Use a piece of window screen or old flour sifter to sift soil over the seeds to the depth indicated on the seed packet.

If you use compartmentalized trays or individual peat pots, place two or three seeds in each pot. Do not cover too deeply, as this may reduce or prevent seed germination. As a general rule, cover no more than four times the diameter of the seed.

Apply a fine spray of water to avoid washing the seed, causing them to float to the soil surface. Household window sprayers are suitable. Cover the containers with plastic sheets or panes of glass and place in a cool room (60 to 65F) away from direct sunlight until germination.

When seeds germinate, move them gradually (over two or three days) into brighter light. When the seedlings have developed the first true leaves (the leaves above the cotyledons or 'seed leaves'), thin to one plant per container if using partitioned trays or peat pots. Use tweezers to pinch off unwanted seedlings rather than pulling them, to avoid disturbing the remaining seedling.

If seeds were planted in larger containers, transplant into individual peat pots or other small containers. An alternative is to thin the seedlings so they are spread about 1 1/2 to 2 inches apart and leave them in the larger containers. This method, however, makes inefficient use of seed and space.

Water seedlings carefully. Small containers used for starting plants dry out quickly. On the other hand, soil kept soaking wet inhibits seedling growth and may kill the plants.

About one week prior to planting-out time, gradually expose seedlings to longer periods outdoors unless temperatures are below 50F. At the same time, reduce watering to a minimum as long as plants do not wilt. This will help the plants adjust to full exposure without undergoing undue shock at planting time.

Table 1: Starting times for seeds grown indoors and in cold frames.

	Number of weeks to start seed before average frost-free date.	
Plant name	**In cold frame**	**Indoors**
Ageratum	6	8
*Amaranthus (summer poinsettia)	4	6
*Bachelor's button	4	4
Broccoli	6	4[a]
Cabbage	6	4[a]
*Calendula	4	4
*California poppy	4	4
Calliopsis	4	6
Cauliflower	6	4[a]
China aster	4	6
*Cosmos	4	4
Dahlia	6	8
Dimorphotheca (African daisy)	4	4
*Gaillardia	4	4
*Gomphrena	4	4
Larkspur	4	6
Lettuce (head and semihead)	6	4[b]
Lobelia	6	8
*Marigold	4[b]	4
*Morning glory	4	4
*Nasturtium	4[b]	4
Pepper	4[b]	6
Petunia	6	8
Phlox (annual)	4	6
*Poppy (Shirley)	4	4
Salvia	4	6
*Scabiosa	4	4
Snapdragon	6	8
Statice	4	6
*Straw flower	4	4
*Sweet alyssum (lobularia)	4	6
Tomato	4[b]	6
Verbena	6	8
Vinca (annual)	4	6
*Zinnia	4	4

*Plants best suited for direct seeding in garden two weeks prior to the average frost-free date.
[a]Should be kept in coolest room. Best at 55F to 60F.
[b]If outside temperatures are below 20F at night, delay planting or use artificial heat to keep temperatures above 50F in cold frame.

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Starting Seeds Indoors

Starting garden plants from seeds indoors can be an enjoyable project for any gardener. It's a relatively inexpensive way to grow a wide variety of plants. Many garden favorites are found in a greater variety of colors, sizes and growth habits as seeds, rather than as started plants.

When selecting vegetable varieties, check packets for the number of days until harvest to be sure your choices will ripen before frost. Many long-season vegetables must be started indoors in early spring. Similarly, many annual flowers need an indoor start if they are to bloom during the summer.

Buying Seeds. Seeds are available from many sources, ranging from your local building supply store to garden centers and mail order catalogs. Their prices can vary greatly. The newest hybrids command higher prices, as do seeds of rare or unusual plants, as well as certified organic seed.

Planting and care information is often more complete on name-brand seed packets. If name brand and "off brand" seed varieties are the same for a given flower or vegetable, there shouldn't be any difference in the plants' ultimate quality. The percentage of germination and seed purity is governed by law.

Many companies sell different sizes of seed packets, from mini-packs of as few as ten seeds to seeds by the pound. Although smaller quantities cost more per seed, don't buy more seed than you will use in two or three years. Each seed contains a plant embryo that must stay alive until it can germinate. The fresher the seed, the greater the chances that all the seeds will still be viable. Fewer and fewer seeds from a packet will germinate as time passes.

Leftover seeds can be saved for the next year, however. As soon as you're done planting, store seed packets in an air-tight container in a cool place: the refrigerator is ideal. To keep the humidity low in the container, add a packet of silica gel. A teaspoon of powdered milk in a piece of facial tissue or paper towel will also absorb moisture.

Containers. Start seeds in small, individual containers. It's best to use divided containers with a single seedling per container, rather than filling a larger container with potting mix and sowing many seeds, because the seedlings' roots will grow into each other and are likely to be injured later during transplanting. Exceptions to this rule are onions and leeks from seed. These can be started in one larger flat and transplanted out into the garden while still small without harm to the seedlings.

Plastic sheets of small containers, called "cell flats," fit into standard solid trays. Small individual plastic pots are also suitable. All seed starting containers must have drainage holes at the bottom.

Most plastic seed-starting containers are reusable, but may harbor plant pathogens once used. Sterilize used containers by soaking the cleaned cups in a solution of bleach or other disinfectant for 30 minutes, then rinse and use. Mix the solution to the strength recommended on the label for disinfecting surfaces.

There are many kinds of fiber pots made from organic materials such as peat, cow manure, and shredded wood. Some gardeners make pots from strips of newspaper. Fiber or paper pots that break down in the soil are particularly good for raising seedlings that don't transplant well, such as cucumbers and squash.

Many gardeners use clear plastic domes that fit over trays of plants. These domes allow light in, but help keep moisture from escaping. They can also help retain heat provided to the root zone. Obviously, the domes have to be removed when the seedlings are tall enough to touch them!

Soilless Seed Starting Mixtures. Commercial seed-starting mixes, usually composed of vermiculite and peat, without any true soil, are recommended for starting seeds. They're sterile, lightweight and free from weed seeds, with a texture and porosity especially suited to the needs of germinating seeds and tiny seedlings.

Set the cell flats or containers into a solid tray, fill them with potting mix, and water the mix before sowing seeds. The potting mix will settle down into the containers, sometimes dramatically so. Add more potting mix and water again, until the containers or cells are nearly full.

Timing. Follow seed packet or catalog instructions, as each species has its own requirements. Heat-loving vegetables such as tomato, pepper, and eggplant are usually started in early spring. Cabbage and broccoli intended for fall crops may be started indoors in June or July.

Month of	Indoor growth	Vegetable
Early February	14-15 weeks	Leeks, onions
Mid February	12-13 weeks	Celery
Early March	10-11 weeks	Broccoli, cabbage, cauliflower, head lettuce
Mid March	8-10 weeks	Peppers, eggplant, tomatoes

Sowing Seeds. Sow fresh seeds individually into each container according to package directions. If you are unsure about seeding depth, a rule of thumb is to plant a seed four times as deep as its width. Think of it as planting a seed deeply enough that three more seeds could be placed directly above it. Mark each pack with a tag, either purchased or made by cutting strips from plastic jugs. Use permanent marker.

Some seeds require light to germinate. Cover them with a thin layer of fine vermiculite, porous enough to permit light to penetrate yet keep the medium moist enough to encourage seed germination. Place cell packs containing seeds that need darkness for germination in dark plastic bags or cover them with several layers of newspaper until seeds sprout.

When using older seeds with lower germination rates, plant two or more seeds per cell. Once the seedlings have developed true leaves, cut all but the healthiest one off at ground level with scissors. If you try to separate and transplant seedlings, or try to just pull the unwanted seedlings out, you're likely to damage the roots of the one you want to keep.

Location. A windowsill is not a good location for starting seeds. If you're starting only a few plants and have roomy window sills, a south-facing window may be all the growing space you need. But window sills can be the coldest place in the house, especially at night, and then the hottest during the day. Although sunlight gains strength through April and May, the months when seeds are usually started and seedlings kept indoors, sunlight through a window is relatively weak, compared to artificial light sources kept close to the plants.

Most seeds need consistently warm soil to germinate and produce strong roots. Cooler soil temperatures can also lead to seedling death due to disease. Excess heat during the day can completely dry out the potting mix, again leading to seedling death. Even if windowsill temperatures are controlled, light coming from the side, rather than from above, will encourage bent, rather than straight stems. Windowsill-grown seedlings tend to be excessively tall, with thin, bent stems. Finally, starting seeds on a windowsill can lead to water damage to the woodwork.

Instead, choose a place safe from heavy traffic, pets, cold drafts, and excess heat; where spills of potting mixture, water, or fertilizer will not be a problem. Allow space to accommodate later sowings of seed, as well as the space the seedlings will take up as they grow and are transplanted to larger containers. Air temperatures above 60°F are adequately warm if bottom heat is provided, so even a basement can be a good place to start seed.

Light. It's much better to grow seedlings under fluorescent lights than to rely solely on natural light, even in a greenhouse. Some brands of lights are sold as "grow lights," designed to provide light in specific ranges required by plants, but standard fixtures with two "cool white" fluorescent tubes per fixture also give plants adequate light and are inexpensive. A combination of cool white and natural daylight tubes would provide good light for plants that is more appealing to people.

Hang lights from chains to ease raising them as the plants grow. Keep lights no more than 4 inches above the tops of your seedlings: as close as 2 inches is ideal. Lack of light is the major cause of elongated, skinny stems. Plants need 12 to16 hours of light daily, but don't leave the lights on continuously, as many plants need some dark period each night to develop properly. A simple timer can be part of the set-up.

Bottom Heat. Providing a constant heat source from underneath can be very beneficial to seedlings. Temperatures in the potting mix of indoor containers can be as much as 5°F lower than indoor air temperatures. Seeds of most plants started indoors germinate sooner and produce healthier roots when the potting mix is warm, and bottom heat can help to prevent "damping off," the death of tiny seedlings due to pathogens at the surface of the potting mix. Electric heating mats specifically for seed starting are available from many garden centers and mail-order suppliers. If you use a timer for lights above the seedlings, don't plug the heat mats into it!

Water and Fertilizing. Keep the potting mix moist while the seeds are germinating. A spray bottle to water the surface gently without washing the potting mix out of the containers may be useful, or water can be added to the tray and allowed to move up into the mix. In either method, drain excess water that remains or accumulates in the tray, to keep roots healthy.

Seedlings draw energy for germination from nutrients stored in the seed. They don't need fertilizer until they have several sets of true leaves. Seedlings grown in a soil-less mix will benefit from a weak general purpose water-soluble fertilizer mixed 1/4 strength. Fertilize only once a week. Water as needed the rest of the week with plain water.

Transplanting. Transplant seedlings that outgrow the cell packs into larger containers. Larger peat pots or Styrofoam or plastic cups with holes punched in their bottoms are excellent. Lift seedlings by the root ball, using a spoon or plant tag for support if necessary. Never hold the seedling by its stem, as you may crush it, or harm the growing tip. If you feel the need to steady the plant from above lightly hold the plant by a leaf. A seedling that has lost a leaf can grow another, but a seedling that has lost its growing point cannot survive. Larger seedlings in larger containers will require more space and often another set of lights.

Moving Seedlings Outside. Plants started indoors will not have been exposed to full sun, wind, or widely fluctuating temperatures. If they are not gradually accustomed to the outdoor environment, a process called "hardening off," their leaves maybe scorched by sun or wind; they may even wilt and die.

About two weeks before planting outdoors, start hardening off the seedlings by moving them outside for increasingly longer periods each day. Start by putting them outside for a few hours in the shade during the warmth of the afternoon. Choose a spot protected from wind. Bring them back inside for the night before temperatures start to drop. Each day, leave the plants out a little longer, and expose them to a little more direct sunshine. By the end of two weeks, unless freezing temperatures are forecast, the seedlings can stay outside in a sunny area until you are ready to transplant them into the garden.

An easy way to harden plants off is to place them in a cold frame, a temporary mini-greenhouse. Commercially produced cold frames are available in many designs. They are also simple to construct. Adjust the lid of the cold frame as needed to protect plants from freezing temperatures, often closing it at night, but vent the lid a bit farther each day to accustom the plants to wind and cold.

Once they have been hardened off, seedlings can be set out in the garden. Transplant on a cloudy day or late afternoon when the sun has passed its peak. Even hardened off plants may wilt when first exposed to full sun, but they generally recover within a day or so. Row covers and other types of plant protectors can help even plants get off to a good start in the garden by reducing damage from wind and temperature fluctuations.

When transplanting seedlings grown in peat pots, newspaper pots, cow-dung pots, or any other containers made of organic matter, trim the pots down to soil level. The collars of these pots, exposed to drying air, will wick water away from the root zone. To encourage roots to spread out into garden soil, carefully cut or tear holes in the bottoms of these pots, because they usually don't break down completely in the soil, and may inhibit root growth.

Nine Common Mistakes for Growing Plants from Seed

1. Not Enough Light - too much is better
2. Too Much or Too Little Water – damp off, fan to move air
3. Starting Too Soon – tall, leggy plants
4. Planting Too Deep – won't germinate
5. Tough Love – hardening off
6. Getting Seduced – don't do more than you can handle
7. Too Cool – warming mats
8. Labeling Issues – popsicle stick, tooth pick, Sharpie
9. Biggest Mistake – don't give up

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