



Department of Horticulture

Purdue University Cooperative Extension Service • West Lafayette, IN

Starting Seeds Indoors

*Michael N. Dana and B. Rosie Lerner**

Growing annual flowers and vegetables from seeds started indoors can be rewarding. Vigorous plants started indoors and then transplanted will flower sooner and produce an earlier harvest than those started directly outdoors. Home gardeners can also grow cultivars which may not be available from local nurseries as transplants.

Selecting Seeds for Planting

Purity and trueness to type—Good seeds should not contain seed of other crops or weeds and should be the correct cultivar. For best results, buy quality seed from a reliable dealer. In Indiana, vegetable seeds must meet minimum germination standards prescribed by law. If they fall below the legal minimum, the germination percentage must be shown on the package.

Packages and storage—Seeds sold in packages should show the crop, cultivar, germination percentage, and chemical seed treatments, if any. Seeds should be kept dry and cool to insure good germination at planting. Laminated foil packets insure dry storage. Paper packets are best kept in tightly closed cans or jars until seeds are planted.

Hybrid seeds—Many new vegetable and flower seeds are hybrids. Hybrid seed often costs more than seed of non-hybrid cultivars. However, hybrids usually have increased vigor, better uniformity, larger yields and sometimes specific disease resistance or other unique cultural characteristics. Each gardener must decide whether the added benefit justifies the added cost. It usually does.

Saving your own seed—Some experienced gardeners save their own seed. This practice requires the gardener to know the proper techniques for selecting, producing, handling, and storing the seed. Seed from hybrid plants should never be kept. Likewise, it may be unwise to keep seed from plants that are easily cross-pollinated, such as sweet corn, squash, and pumpkins. Bean seed may carry viruses and other diseases from one season to the next.

Containers for Sowing Seeds

Containers for starting seeds should be clean and sturdy and should fit into the space available for growing plants in the home. Having the proper container helps get seedlings off to a good start and may save work in later stages of seed development.

Wood flats, fiber trays, plastic trays—Plants that are easy to transplant may be seeded directly in flats or trays for later transplanting into individual pots or wider spacing in flats. Starting seeds in such containers saves space as compared to seeding directly into individual pots. However, where time is more important than space, direct seeding in pots may be preferred.

Clay and plastic pots—Both types can be cleaned and reused and are excellent for growing transplants. Plants to be transplanted must be removed, and the soil ball must be carefully cut apart at planting time. Seeds may also be planted directly into the pots.

Peat pots—These popular pots are made from peat or paper waste fibers and may be purchased individually or in strips or blocks. They are porous and provide excellent drainage and air movement. The entire pot can be planted, so there is minimum root disturbance at planting time.

Compressed peat pellets—When dry, expandable peat pellets are about the size of a silver dollar, but somewhat thicker. When placed in water, they swell to form a cylindrical container filled with peat moss, ready for seeding or transplanting. They may be planted directly into the garden. Use the pellets in trays so they are easily watered and held upright. Be sure they are placed so the open side is up.

Plastic flats, packs, and plugs—An increasing number of different types of plastic flats and packs are now being sold. In many types, you grow each plant in a cell and then merely “pop” it out at planting time. With care, these plastic flats and packs can be reused.

Soil Mixes and Other Growing Media

The medium used for starting seeds should be loose, well-drained, and of fine texture. You may use commercially prepared mixes or you may mix materials yourself.

Vermiculite—This material when used alone provides good seed germination. It is clean, and if not contaminated during handling, will not need sterilization. If other seeding mixes are used, it is useful for covering seeds. It does not form a crust, and seedlings can easily emerge. Vermiculite is available in several grades. For seeding, a fine grade is best.

Suggested Soil Mixture

| Ingredients | 1 gallon | 1 bushel |
|--|----------|--------------------------|
| Shredded sphagnum peat moss | 2 qts | 1/2 bu |
| Vermiculite #3, or 4 | 2 qts | 1/2 bu |
| Limestone, dolomitic preferred | 1 Tbsp | 6 Tbsp |
| 20% superphosphate (powdered) | 1/2 Tbsp | 2-1/2 Tbsp |
| 5-10-5 | — | 7-1/2 Tbsp |
| Iron (chelated such as NaFe, 138 or 330) | — | 1/2 tsp |
| Wetting agent ¹ | — | 1/2 tsp in 1/2 gal water |

¹Wetting agents or surfactants increase the ease of wetting peat moss and mixes high in organic matter. A small quantity added to water will help to uniformly distribute applied water. Dish detergent may be used as a wetting agent at double the recommended rate. Note: Bushels are level full, not packed. Tablespoons and teaspoons are level amounts.

Synthetic mixtures—Mixes that contain no soil are available for growing seeds. These contain either a combination of peat moss and vermiculite or peat moss and perlite. They may be purchased ready-made or can be mixed at home. These mixes as well as vermiculite used alone, have little fertility. Seedlings must be watered with a diluted fertilizer solution soon after they emerge. (See section on Fertilization under Growing Seedlings).

Soil-vermiculite mix—Seeds may be started in a mixture of about one-third loam garden soil and two-thirds vermiculite. Since good soil contains some fertility, prompt fertilization after germination is not essential. When garden soil is used, the mix must be sterilized before seeds are planted in it.

Soil-peat-sand-mix—Large seeds or vigorous-growing seeds may be planted in a mix of two parts loam garden soil, one part shredded peat moss, and two parts of either perlite, vermiculite, or sharp sand. Soil sterilization is necessary.

Milled sphagnum moss—A ground sphagnum moss is sometimes used for starting seeds, since it inhibits the seedling disease damping-off. It should be well-moistened before use. Since it contains no fertility, prompt fertilization is essential after seeds have germinated.

Layered mixes—Another technique used for germinating seeds is to partially fill a flat or pot with sterilized soil mix, and then top it with a layer of vermiculite or milled sphagnum moss in which the seeds are planted. After germination, roots of seedlings move from this top area into the soil mix, which provides fertility. Adding liquid fertilizer is less critical. Figure 1 illustrates this technique.

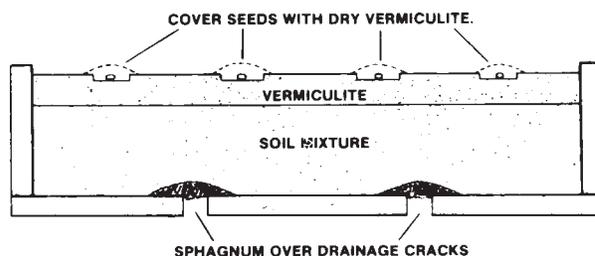


Figure 1. After germination, seedling roots move into the soil mix, which provides fertility.

Peat humus—Exercise caution using peat humus (or Michigan peat) in the place of sphagnum peat moss in seed germination mixes. There is wide variation in the water holding capacity, aeration characteristics and pH of the products sold under the name peat humus. It is safer to insist on sphagnum peat moss or used milled sphagnum moss.

Sterilizing Mixes and Containers

To guard against damping-off and other plant diseases carried in the soil and on containers, be sure to clean and sterilize materials.

Mixes—Place the moist, but not wet, soil mix in a container which can be covered to keep the soil from drying rapidly. If a cover is not available, use aluminum foil, and seal it down at the edges. The mixes may be sterilized directly in the pots or flats in which they are to be used. In addition to killing disease organisms, many weed seeds are killed by sterilization.

Pinch a small hole in the center of the foil, and insert the bulb end of a meat or candy thermometer into the soil so that the bulb is in the center of the soil mass. Place the pan in an oven at 200-220°F (93-105°C). Keep the soil in the oven until the thermometer shows a temperature of 160-180°F (71-82°C). Remove the pan and allow it to cool. Baking the soil will give off a strong odor, so some ventilation may be desirable. The time necessary for sterilization depends upon the volume of the soil, as well as its moisture content. Dry soil cannot be sterilized well.

Some home gardeners prefer to place a raw potato in the center of the soil and bake in a medium oven until the potato is done.

After the soil has been sterilized, make sure the containers, tools, and working area are also clean and sterile. Clean soil can be easily re-infected by careless techniques. *In sterile soil, reintroduced diseases may spread faster than they would in unsterilized soil.*

Containers—All containers that have been used should be washed thoroughly in soapy water to remove all debris. Do not put wooden flats or plastic containers in the oven. Rinse wood and plastic items in a solution of one part chlorine bleach and ten parts water. Let them dry before filling with soil.

Seed—Many seeds are pre-treated with a fungicide to protect the seed from diseases such as damping-off. These seeds may be dusted with a white, pink, green, or blue color fungicide. If seeds have not been treated, dust them with a fungicide before sowing. Be sure to wear gloves when handling the fungicide.

Seeding

The proper time for sowing seeds depends upon when plants may normally be moved outdoors. The periods range from 4 to 14 weeks, depending upon the speed with which seedlings grow and the conditions in the home (see Table 1). *Read the label on the seed packet for any planting directions.*

1. Fill the container to within 3/4 inch from the top with the mixture to be used. If it is dry, moisten the mixture before filling. Make sure that the container has adequate drainage. Before filling, cover holes or cracks in the container with sphagnum moss or broken crockery.
2. Level and gently firm the planting medium. Use a clean small board for leveling and firming. Do not press too hard in firming the surface or poor aeration and decreased root growth will result.
3. Make shallow rows about 1-2 inches apart in the flat using a narrow board or large wooden marker label (Figure 2). When different seeds are used in the

same container, they are easier to keep track of if planted in rows. If only one type of seed is used in each flat, then seed may be scattered or broadcast over the surface.

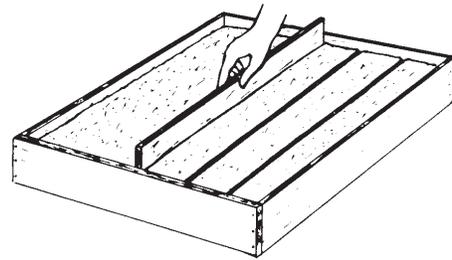


Figure 2. A shallow row about 1 to 2 inches apart in a seed flat.

4. Sow seeds uniformly and thinly in the rows. Many small, round seeds may be slowly dropped into the rows by tapping the package as it is held over the rows (Figure 3). Label each row promptly with plant type, variety, and date of planting. Use pencil or waterproof pen for labeling.

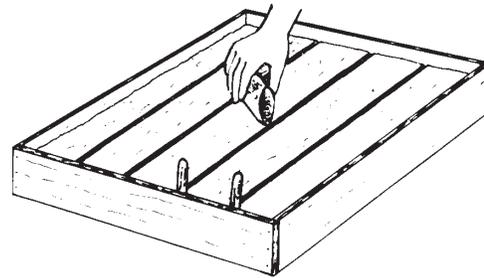


Figure 3. Round seeds may be slowly dropped in the rows by tapping the package as it is held over the rows.

Plant large seeded vegetables, such as cucumber, muskmelon, and watermelon, directly into peat pots. Other seeds may also be handled this way to save transplanting, but sowing is difficult with very small seeds. Plant two seeds per pot and later thin to one plant. This saves later transplanting and means less root damage at planting time.

5. Cover the seeds with dry vermiculite or milled sphagnum moss. The depth of covering depends upon the size of the seeds. Very fine seeds, such as petunia or begonia, should not be covered. Moisten the surface with a fine mist, or place the container in a pan of warm water to absorb moisture from the base. Do not place containers in water that is deep enough to run over the top of the pot or flat. It may mix seeds or cover them too deeply. Bottom watering helps avoid damping off by keeping the soil surface dry. As a general rule, seeds other than very fine seeds should be covered with soil to a depth of about two times their diameter.

6. Cover the container with polyethylene plastic film (a clear bag will do) or a piece of window glass. Since they retain moisture, no additional watering should be necessary until after seeds have germinated.
7. Place seeds in a warm location for germination. Generally a temperature range of 65-75°F (18-24°C) is best. A few plants, such as larkspur, snapdragon, sweet pea, cabbage, broccoli, and cauliflower, are best started at about 55°F (13°C). *Do not place covered containers in direct sunlight.*
8. Watch daily for germination. Move to bright light, and remove plastic or glass coverings as soon as germination is well underway. If all seeds do not germinate at the same time, cut strips of plastic or cloth and keep ungerminated rows covered until seedlings appear. Seeds are quickly killed if allowed to dry during germination. Watch closely for development of damping-off, and control promptly.

After germination, place those plants listed as preferring cool temperatures in cool location.

Damping-Off

When seedlings fall over at the groundline, they are being attacked by a fungus disease known as damping-off. If only a few seedlings are attacked, dig out and discard the infected plants and soil, taking care to dig well into the uninfected portion of the soil. Drench the entire soil mass with a fungicide if the disease is scattered throughout the flat or pot. This may not provide complete control. High temperature, poor light, or excess moisture stimulate spread of the disease by weakening plants to make them more susceptible to it. The best control is cleanliness and prompt action when the disease appears.

Growing Seedlings

After seeds have germinated, they must be promptly given the best possible growing conditions to insure stocky vigorous plants for outdoor planting. Cultural requirement must be considered carefully.

Light—Seedlings must receive bright light promptly after germination. Place them in a bright south window if possible. If a large, bright window is not available, place the flats under fluorescent lights. A fixture containing two fluorescent tubes is adequate. Use a combination of 1 cool white tube and 1 warm white tube. Place the seedlings 3-4 inches from the tubes, and keep lights on for 14-16 hours each day. An automatic timer is useful.

Be aware that fluorescent tubes produce poorer light quality and lower light intensity with age. If seedlings are

correctly placed under lights and become spindly, it is probably the fault of old fluorescent tubes. Two years is a typical bulb life. New lights will alleviate this problem. As seedlings grow, the lights may need to be raised to prevent leaf burn as seedlings touch the tubes.

Temperature—Most annual plants and vegetables prefer night temperatures of 60-65°F (15-18°C). Day temperatures may run about 10°F higher. If temperatures are warmer than this, leggy plants result. Cool season vegetable crops and a few flowers prefer night temperatures no higher than 55°F (13°C) and day temperatures near 65°F (18°C). An unused bedroom, basement, or sunporch is often a good location.

Moisture and watering—Good air humidity is an asset for producing good plants. A humidifier may be placed as close to the growing area as possible. Flats should never be over-watered. Allow drying between waterings, but do not allow seedlings to wilt at any time.

Fertilization—Seedlings will need some fertilization for best development. Those in totally artificial mixes without fertilizer need prompt and regular fertilization. Use a soluble house plant fertilizer such as 15-30-15 or similar analysis. Young, tender seedlings are easily damaged by too much fertilizer. Apply fertilizer at about half of the recommended strength a few days after seedlings have germinated. After that, fertilize at 2-week intervals with the dilution recommended by the manufacturer.

Transplanting and Thinning

As soon as seedlings have developed at least one set of true leaves and are large enough to handle, they should be transplanted to individual pots or spaced out in flats. Failure to transplant promptly results in crowded, spindly seedlings that will not develop properly. If a hotbed is available, seedlings may be transferred directly to it. Artificial mixes or a soil mix of one part soil, one part sphagnum peat and one part sand may be used.

To transplant, carefully dig up the small plants with a knife, spatula, or wooden label. Let this group of seedlings fall apart, and pick out individual plants. Occasionally if seedlings have been too close, they are difficult to separate. Gently ease them apart in small groups which will make it easier to separate individual plants. Avoid tearing roots in the process. Handle small seedlings by their leaves; small thin stems break and crush easily.

Poke a hole into the soil where the seedling will be planted. Make it deep enough so that the seedling can be put at the same depth it was growing in the seed flat. Small plants or slow growers may be placed 1 inch apart and rapid growing, large seedlings may be positioned about 2 inches apart. After planting, firm the soil and water gently.

If seeds were sown in individual peat pots or pellets, thin to one seedling per pot at this time. Do not pull the extra seedling out as this will disturb the roots of the remaining seedling. Simply cut it off with scissors.

Keep newly transplanted seedlings in the shade for a few days, or place them under fluorescent lights. Keep them away from heat sources. Continue watering and fertilizing as was done in the seed flats.

Vegetables easily transplanted include broccoli, cabbage, Brussels sprouts, lettuce, and tomatoes. Those with a little slower root development include cauliflower, celery, eggplant, onion, and pepper. Plants that do not transplant well and therefore are seeded in individual pots include cucumber, muskmelon, squash, and watermelon.

Most flowers normally grown indoors transplant well, but a few that are difficult to transplant include poppy, larkspur, lupine, sweet pea, and cornflower. These are generally seeded outdoors; but to start them indoors, place them directly into individual pots.

Pinching

Most annual flowers respond to pinching, which encourages side branching. Usually the top inch or two is removed from the growing tip, leaving 3 or 4 leaves. *Do not pinch vegetable plants.*

Moving Plants Outdoors

Hardening—Plants which have been growing indoors cannot be planted abruptly into the garden without danger of injury. To prevent damage, they should be hardened before planting outdoors.

This process should be started 2 weeks before planting in the garden. If possible, plants should be moved to cooler temperatures outdoors in a shady location. A cold-frame is excellent for this purpose. When first put outdoors, keep in the shade, but gradually move plants into sunlight for short periods each day. Gradually increase the length of exposure. Do not put tender seedlings outdoors on windy days or when temperatures are below 45°F (7°C). Reduce the frequency of watering to slow growth, but do not allow plants to wilt. Even cold-hardy plants such as cabbage and pansy will be hurt if exposed to freezing temperatures before they have been hardened. After proper hardening, however, they can be planted outdoors and light frost will not damage them.

Planting into the garden—When plants have grown large enough to handle easily and hardening is complete, they may be planted into the garden when weather conditions permit.

Carefully remove plants from the growing flats, retaining as much soil as possible around the roots. Dig the hole about twice as large as the soil mass around the roots. Set the plants at about the same level they have been growing in the pots. A few plants such as tomato and marigold are able to develop roots along the stem. If they have become leggy, they may be planted deeper than they were previously growing. Place soil loosely around the roots, and apply about one cup of a starter fertilizer solution. This solution is made by dissolving 1 tablespoon of high-phosphorus fertilizer in 1 gallon of water. A 15-30-15 or similar analysis is satisfactory.

Plants grown in clay and plastic pots must be removed from them before planting. Those growing in peat pots or peat pellets can be planted intact. Breaking the base of the peat pot often helps improve root penetration and drainage. Make sure that the top edges of the pot are thoroughly covered or removed. If not covered, the edge may act as a wick and evaporate moisture from the root ball. This evaporation delays root penetration or even causes the plant to dry up on hot sunny days.

Transplant on cloudy days if possible. In warm, sunny weather, cover the newly planted seedlings with newspaper tents or some other type of shading for 2 or 3 days until they are well-established.

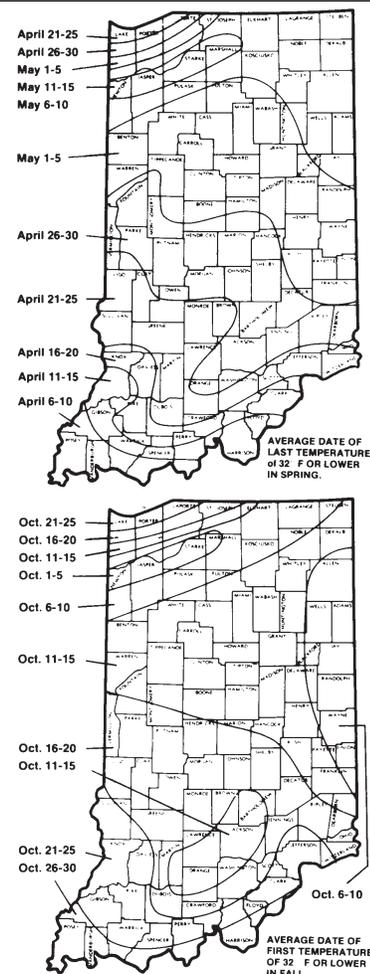


Figure 4. Dates, probabilities, and low temperatures.

Table 1. Guide to sowing vegetable and annual flower seeds in the home.

| Time to Seed Before Last Frost | Plant Types | Germination Time (days) | Growth Rate | Cold & Frost Tolerance After Hardening |
|--------------------------------------|-------------------------------|----------------------------|----------------|---|
| VEGETABLES | | | | |
| 10 weeks | Broccoli* | 6-10 | medium | good |
| 10 weeks | Cabbage* | 6-10 | medium | good |
| 10 weeks | Cauliflower* | 6-10 | medium | good |
| 10 weeks | Head lettuce | 3-5 | medium | good |
| 7 weeks | Tomato | 6-10 | medium | none |
| 7 weeks | Eggplant | 7-14 | medium | none |
| 7 weeks | Pepper | 7-14 | medium | none |
| 4 weeks | Cucumber | 4-6 | fast | none |
| 4 weeks | Cantaloupe | 4-6 | fast | none |
| 4 weeks | Squash | 4-6 | fast | none |
| 4 weeks | Watermelon | 4-6 | fast | none |
| FLOWERS | | | | |
| 14 weeks | Begonia | 10-12 | slow | none |
| 14 weeks | Pansy | 6-10 | medium | good |
| 14 weeks | Violet | 6-10 | medium | good |
| 12 weeks | Lobelia | 15-20 | slow | none |
| 12 weeks | Stocks | 10-14 | medium | good |
| 11 weeks | Black-eyed Susan vine | 10-12 | slow-medium | none |
| 11 weeks | Impatiens | 15-18 | medium | none |
| 11 weeks | Torenia | 10-15 | medium | medium |
| 10 weeks | Petunia | 6-12 | slow-medium | slight |
| 9 weeks | Ageratum | 5-8 | medium | none |
| 9 weeks | Scabiosa | 8-12 | medium | slight |
| 9 weeks | Snapdragon | 7-12 | medium | medium |
| 9 weeks | Verbena | 12-20 | medium | slight |
| 8 weeks | Bells of Ireland | 21+ | medium | medium |
| 8 weeks | Dianthus | 5-7 | medium | medium |
| 8 weeks | Salpiglossis (Painted Tongue) | 8-10 | medium | none |
| 8 weeks | Vinca (Periwinkle) | 10-15 | medium | none |
| 8 weeks | Scarlet Sage (Salvia) | 12-15 | medium | none |
| 8 weeks | Statice | 15-20 | medium | slight |
| 7 weeks | Nicotiana | 10-15 | medium | slight |
| 7 weeks | Nierembergia | 10-15 | medium | slight |
| 7 weeks | Phlox, Annual | 6-10 | medium-fast | none |
| 7 weeks | Sweet Alyssum | 4-8 | fast | slight |
| 6 weeks | Aster | 8-10 | medium | slight |
| 6 weeks | Balsam | 6-8 | medium-fast | none |
| 6 weeks | Celosia (Cockscomb) | 6-10 | fast | none |
| 6 weeks | Cornflower | 6-10 | fast | good |
| 6 weeks | Marigold | 5-7 | fast | none |
| 6 weeks | Portulaca | 6-10 | fast | none |
| 4 weeks | Cosmos | 5 | fast | none |
| 4 weeks | Zinnia | 5-7 | fast | none |

*Note: These vegetables are commonly grown as fall crops as well as spring/summer transplants. Start seeds 5-7 weeks (7-9 weeks for cauliflower) before plant out date. Planting out date depends on length of season for your particular cultivar and the date of first frost for your location(see Figure 4). It will usually be between July 15 and August 1.

*This publication was originally authored by M. N. Dana and Allen E. Boger, Retired Extension Educator, Allen County.

For more information on the subject discussed in this publication, consult your local office of the Purdue University Cooperative Extension Service.

It is the policy of the Purdue University Cooperative Extension Service, David C. Petritz, Director, that all persons shall have equal opportunity and access to programs and facilities without regard to race, color, sex, religion, national origin, age, marital status, parental status, sexual orientation, or disability. Purdue University is an Affirmative Action employer. This material may be available in alternative formats. <http://www.agcom.purdue.edu/AgCom/Pubs/menu.htm>