Introduction

Larkspur, *Consolida* spp., are excellent cut flowers—both for fresh and dried or everlasting markets. Many cut flowers are popular for short periods of time, often attracting public attention for less than 5 years, then fading from demand. The market for good quality larkspur has been strong for many years, past the period of “fad flowers,” and it continues to stay robust. The alluring flower shape, wide range of colors, and appealing foliage all combine to make larkspur a popular, marketable cut flower. The flowers tend to be somewhat fragile and relatively short-lived in the vase (under 7 days), making production for local markets very appealing.

Larkspur grow to their full potential in climates with cool, moist summers. Growers must adopt practices that take advantage of the cooler seasons to successfully grow larkspur during the cool weather of September through heavy frost. Plants

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References


Note: When trade names are included, no discrimination against similar products is intended. Mention of trademarks in this publication does not constitute an endorsement by the Cooperative Extension Service.
established in the fall grow rapidly in cool, moist springs, with heavy flower production in May and June and occasionally into July if the weather remains favorable.

The genus of larkspur was recently changed from *Delphinium* to *Consolida*. Two species of larkspur are used for cut flowers: *Consolida ambigua* and *Consolida orientalis*. *C. orientalis* is more upright than *C. ambigua*, and colors are often shades of bright pink and purple. *C. ambiguа* have more branches initially and colors are usually light pink or blue. Most of the outstanding larkspurs for cut flower production are *C. orientalis* varieties.

**Culture**

**Field Production**

**Propagation**

Larkspur is commonly produced by direct seeding into the field. Some growers start or purchase seedlings grown in greenhouse plug trays, and transplant larkspur plugs into the field or greenhouse growing beds.

Larkspur has a reputation for poor germination. Seeds that germinate best are those planted 4 to 6 months after harvest. Seed 1 year or older often has germination rates of less than 50 percent. Stored seed should be refrigerated until needed, but held for under 1 year. An ounce of seed yields approximately 5,000 plants.

Larkspur seed does not germinate well when soil temperatures are held above 75 °F. Germination will be improved by chilling seed (35 to 40 °F) for at least 7 to 14 days prior to planting. In Maryland, optimum seeding times for field production are from September through heavy frost. Most growers will plant a series of sequence plantings at 2-week intervals. Germination takes place 12 to 20 days after sowing. Once the seed has germinated, the larkspur plants will grow rapidly in cool fall weather. Larkspur plants planted in fall flower 4 to 6 months after planting.

An alternative is to start seeds in a greenhouse during the winter and transplant the plugs in early spring. For greenhouse growing, use a germination temperature of 70 °F, with a light covering of coarse vermiculite. Transplants from the greenhouse should be conditioned at tempera-

**Summary**

- Select larkspur cultivars and site.
- For field production, prepare seed beds in the fall and plant a series of sequence plantings at 2-week intervals.
- Grow plants in full sun, preferably in raised beds with trickle irrigation.
- Monitor for aphids and cyclamen mites.
- Monitor for diseased plants and promptly remove those that are infected.

**Consumer Care**

- Recut stems under water and place flowers in clean warm water containing a floral preservative.
- Avoid temperature extremes such as freezing or temperatures over 95 °F.
- Keep flowers away from rapid air movement.
- Avoid keeping flowers near ripening fruit, which emits ethylene.
• **Pretreatment.** Pulse with silver thiosulfate (STS) to minimize ethylene damage and prolong vase life. Use a commercial silver solution according to label directions, preferably for a 1- to 2-hour treatment. The STS solution must be processed for silver recovery before it can be disposed of down a drain. Commercial devices, such as a Superbatcher, are specially designed to remove the silver from STS. STS is not very stable, giving the solution a relatively short shelf life. Unfortunately, it is not always easy to determine whether your STS solution is still active. Test kits are available to test the solution’s effectiveness.

• **Hydration.** Hydrate in clean, warm water (80 to 90 °F) at pH 3.5 to 4.0.

• **Preservation.** Use a floral preservative for maximum longevity.

• **Temperature.** Refrigerate at 35 to 40 °F.

**Nutrition**

Adding a 1- to 2-inch layer of composted organic material and tilling it in will greatly benefit larkspur growth. Larkspur plants also respond favorably to applications of nitrogen fertilizer. If using trickle irrigation, fertilize on a weekly basis with 100 parts per million (ppm) of complete fertilizer based on nitrogen. Water-driven fertilizer injectors are available that add the correct proportion of concentrated soluble into the irrigation water. If producing larkspur without trickle irrigation, side dress with a complete fertilizer (10-5-10 or 10-6-4 ratio) at 1 pound per 100 square feet of production row.

**Support**

Most larkspur cultivars grow to a height of 3 to 4 feet. Unsupported flowers will often fall over with the stems turning upward. To maintain the quality of cut flowers, one or two layers of net or wire support (6- to 8-inch openings) are recommended to help hold flowers upright.

**Irrigation**

Installing a trickle irrigation system is a worthwhile investment. Irrigation is best achieved using irrigation rowcrop tape or rowcrop emitter tubing that lies down the row with emitters spaced 6 to 12 inches apart. Two or three rowcrop tapes on a raised bed will water several rows of plants across the bed. Coarse soils need more tapes. Water frequently enough to maintain a good soil moisture. Use a screen filter of 100 to 140 mesh to prevent clogging and use a small pressure regulating device set at 8 to 10 psi to ensure the proper operating pressure for the trickle tubing. Tensiometers are devices that monitor soil moisture and can be used to help the grower decide when to irrigate. (For more information, refer to University of Maryland Extension Service Bulletin 312, “Soil Moisture Sensors for Irrigation Management.”)

**Greenhouse Production**

Larkspur is best grown in groundbeds to facilitate production and harvesting. The seeds should be sown from September through November. Maintain temperatures at 50 to 55 °F for 8 to 10 weeks. Raise temperatures to 55 to 60 °F after this time. Larkspur needs day lengths of 16 hours to flower. The day length can be extended with lighting or with 2-hour night break lighting using incandescent lamps.

**Nutrition**

Greenhouse-grown larkspur needs weekly applications of a dilute soluble complete fertilizer (for example, 20-10-20 or 15-5-15 ratio) at 100-200 ppm based on nitrogen.
Cultivars

• *Consolida orientalis*:
  - **Giant Imperial series**—The standard of the industry. Plants grow 3 to 4 feet tall. Colors: carmine, deep blue, deep rose, light blue, lilac, pink, salmon, and white.
  - **Messenger series**—Plants are 3 to 4 feet tall and flower 2 weeks earlier than the Giant Imperial series. Colors: blue, lilac, rose, and white.
  - **Early Bird series**—Earlybird flowers 2 to 3 weeks earlier than Giant Imperial. Plants are 3 to 4 feet tall. Colors: blue, lilac, rose, white, and mixed.
  - **QIS series**—Very uniform plants and thick stems. Plants grow 2 to 3 feet tall. Colors: carmine, dark blue, light pink, lilac, rose, white, and mixed.

Pests

**Major Diseases**
The most important diseases of larkspur cut flower production are damping off of seedlings (*Pythium* and *Rhizoctonia* fungi), Botrytis, powdery mildew, and Southern blight.

**Damping off and seedling root rots**
Several species of the water mold *Pythium* attack larkspur seedlings. Both cool and warm temperature species are reported. Wet conditions favor *Pythium* diseases. *Pythium* may rot the germinating seed (preemergence damping off), or cause root rot that stunt or kills seedlings (postemergence damping off). *Pythium* produces a tan, water-soaked appearance in roots and stem. The root cortex may slough off leaving the white root vascular cylinder exposed, like fine white threads.

blossoms have fully opened. If shipping the flowers, try to harvest before the lower one-third of the flower stem has opened. For direct markets, you may choose to harvest when one-half to three-quarters of the flower stem has opened. The vase life of larkspur is between 5 to 7 days. The flower blooms are highly sensitive to ethylene and will shatter in its presence. To hold larkspur for 1 to 2 days, place stems in fresh water, keeping them upright and maintaining temperatures of 34 to 40 °F.

**Everlasting sales**
Larkspur are relatively easy to dry for sale as everlasting flowers. For everlasting flowers, harvest when the majority of the flowers have opened, but before the bottom flower petals have dropped. The feathery foliage does not need to be removed when drying the flower stems. Air dry the flowers by hanging flower stems upside down and drying at 70 to 80 °F for 10 to 14 days. A well-ventilated drying barn is ideal for preserving larkspur.

Postproduction Factors

**Retail handling**
• **Recut stems.** After bringing larkspur in from the field, recut stems under water to prevent a water uptake blockage.
• **Ethylene.** Flowers are highly sensitive to ethylene, with resulting premature dropping of flowers. Flowers will react when exposed to ethylene at 3 ppm for 24 hours at 70 °F. Causes include shipping with mixed-fruit or decaying plant material.
Chemical control of cyclamen mites

Since cyclamen mites are found in cryptic (small, hidden) locations on the plant, spray applications must be made as a fine mist. Use of a spreader sticker to increase chance of contact with the pest is recommended. Check with your local Cooperative Extension office for currently labeled miticides. Usually, the best action is to destroy infested plants before the problem spreads in the planting.

Weed Control

To maximize both floral quality and quantity, weed control is essential in both field and inground greenhouse production of larkspur. Competition for nutrients, moisture, and light can be reduced with a good weed control program. In a greenhouse, soils can be steam sterilized at 160 °F for 30 minutes to kill most weed seeds. A weed barrier of 2- to 4-mil black plastic with holes made for placement of plant plugs or seeds can greatly reduce the need for weeding. Unfortunately, the black plastic tends to cause the soil temperatures to rise, which will affect the quality of the larkspur crop. A light layer of leaves or bark can be laid over the black plastic to reduce the heat buildup.

Another option for weed control is to use organic mulch as a surface application. If seeding is done in the fall, a 1-inch organic mulch layer (composted leaves or grass clippings) can be applied close to the plants after they germinate. The mulch layer will reduce germination of fall-germinating weeds. In the spring, if the organic mulch layer has thinned out, an additional 1-inch layer can be placed on the soil to reduce germination of spring-germinating weeds.

Glyophosphate (sold under several brand names, including Round-up) can provide postemergent control of grasses and broadleaf weeds. Apply a 33 percent Glyphosate solution with a wick applicator. Use extreme caution with this solution. Be careful not to make contact with the larkspur or the Glyphosate will kill your desired plants as well as the weeds.

Some growers have used methyl bromide to fumigate the soil before direct seeding of larkspur. Used for years, this soil fumigant kills weeds, seeds, and many insect and disease species. It is presently still available for use by certified pesticide applicators, but is being phased out of the market because it is extremely toxic. Basamid (granular formulation) can also be used as a soil fumigant and is much safer than methyl bromide.

Harvesting Larkspur

Fresh market sales

Larkspur flowers start opening from the bottom and progressively open up from the flower stem to the top. For fresh market sales, harvest when several lower emergernts must be applied after the larkspur seed germinates to prevent inhibit of larkspur germination. If plants are established in the fall, preemergent herbicides can be applied to weed-free soil around growing plants in the spring to control spring-germinating annual weeds. The preemergent Dautchel prevents germination of several annual weed grasses and a few broadleaf annual weeds. The preemergent Pennant is effective against annual grasses, yellow nutsedge, and several broadleaf annual weeds. Check with your local Cooperative Extension Service for current recommendations on other preemergent herbicides labeled for use in field-produced cut flowers.

The fungus *Rhizoctonia solani* can also cause damping off and seedling blight. Usually *Rhizoctonia* is favored by warm conditions. When compared to *Pythium*, *Rhizoctonia* lesions are more defined, with tan, sunken areas. Sometimes the light tan, fine “cob web” mycelium of *Rhizoctonia* can be seen on blighted plant parts and growing across the soil surface.

To differentiate *Pythium* from *Rhizoctonia*, use an Alert on-site diagnostic kit. This will permit you to select the correct fungicide for control.

Basic good horticultural practices, sanitation, and providing optimum conditions for seed germination and seedling growth can prevent most damping-off losses. Selecting a well draining media and watering early in the day so soil drains well before nightfall helps control *Pythium*. SoilGard, a biological fungicide, can be added to media to provide excellent control of both *Pythium* and *Rhizoctonia*.

**Botrytis blights**

Botrytis can attack seedlings, but it is especially damaging when it spots and blights flowers. High humidity and a film of water on plant surfaces is necessary for Botrytis to infect plant tissues. Thus, any cultural practice that reduces periods of leaf wetness (trickle irrigation, plant spacing to improve air circulation, use of horizontal air flow fans in greenhouses, etc.) will reduce the risk of Botrytis.

Botrytis produces a small, defined spot that may rapidly enlarge to blight the flower, leaf, or stem. Weak plant tissues such as yellowing senescent foliage, flower petals, and wounds are easily invaded by Botrytis. Under humid conditions a gray mold is produced on blighted tissues. This gray mold is diagnostic of Botrytis. Look for this aerial gray mold early in the morning or incubate damaged tissues in a moist chamber overnight to promote the formation of spores.

The Botrytis fungus has developed resistance to several major classes of chemical fungicides, including the benzimidazoles (e.g., Cleary’s 3336 and Domain) and the dicarboximides (Chipco 26019), making chemical control difficult. When extended periods of wet overcast weather occur, it may be helpful to spray with mancozeb or use Exotherm Termil smoke in the greenhouse. The copper fungicide Phytan 27 is also registered for Botrytis control on flowers.

**Powdery mildew**

Some larkspur cultivars are susceptible to powdery mildew caused by the fungus *Erysiphe polygoni*. Symptoms include twisted and distorted foliage and white spots and patches on foliage, stems, and buds. Flower buds may fail to open and flowers may be distorted and unsalable. Weather conditions that favor powdery mildew are sunny, warm, dry days, and cool nights.

Several systemic fungicides (e.g., Funginex, Terraguard, Strike, Banner) and summer oil sprays all provide good control of powdery mildew. Some larkspur cultivars are less susceptible. Keep good records of disease incidence on each cultivar you grow; you can then select resistant cultivars.

**Southern blight**

The Southern blight fungus *Sclerotium rolfsii* (also called *Sclerotium delphini*) by some authors) can be a serious problem in field-grown larkspur during hot weather. The fungus remains in the upper inches of field soil and is only active during periods of hot weather when soil temperatures rise into the upper 70s. The fungus attacks the plant at the soil surface, causing a rapid wilt and crown rot of individ-
ual scattered plants in the field. Close inspection of wilting plants will find white wefts of mycelium on the stem, often webbing soil particles and mulch to the stem. The small (about 1/8 to 1/4 inch), spherical, white to brown sclerotia are formed on stems and soil. Presence of the sclerotia is diagnostic of Southern blight.

Several management practices will reduce Southern blight. Deep tillage buries the sclerotia and will reduce the disease because the sclerotia require warmth and oxygen to grow. Incorporating organic matter will help by promoting decay of the sclerotia during the fall, winter, and spring. Wilting plants should be promptly removed along with any mycelium and sclerotia to reduce further increase in fungal inoculum in the field. Fungicide controls and biological agents that decay the sclerotia are in development and may soon be widely registered.

Miscellaneous leaf spots

A number of fungi (Cercospora, Ramularia, Ascoscyta, Phylosticta, Septoria) are reported to cause leaf spots on larkspur. Lab examination is needed to differentiate these minor leaf spot diseases. All are promoted by extended periods of leaf wetness. Fungicide sprays can prevent infections and reduce spread if applied promptly when first leaf spots are seen. However, leaf spots are seldom serious enough to justify a preventive spray schedule. If you experience unusually prolonged periods of wet weather, the fungicides Cleary’s 3336, Daconil 2787, Protect TO, and others would be effective in preventing most leaf spots.

Major Insects

Aphids

Aphids can rapidly become a major pest in larkspur plantings if the population is left unchecked. Large populations of aphids will result in noticeable honeydew accumulations on foliage and flowers. Sooty mold fungus will grow on the honeydew. Since aphids feed on plant phloem, they compete with the plant for nutrients. Heavy populations may measurably reduce plant growth and vigor.

Before you attempt to control aphids you need to identify the species of aphid. Samples can be submitted to your local Cooperative Extension office for identification. Note how fast they reproduce; whether they have a preference for feeding on only certain parts of the plant, or a preference for feeding on certain species or cultivars of plants. One species of aphid that is commonly found on larkspur is the green peach aphid, Myzus persica. This aphid species is very difficult to control with chemical applications.

Biological control of aphids. Aphid populations can be controlled by naturally occurring parasites and predators. If populations of aphids are detected at the early stage of development, you have the option of using beneficial insects to control aphid populations. Aphisidota aphidimyza, a midge insect in the order Diptera, can be used for controlling aphids that are difficult to control with chemicals such as the green peach aphid. This midge lives an average of 10 days and lays eggs close to aphid colonies. The resulting orange midge larvae can kill aphids by biting them at the knee joint and injecting a paralyzing toxin. They grow to maturity over a 3- to 5-day period. They will kill from 40 to 60 aphids each, depending on the aphid density. The midge will reproduce in the field. For pupation the larvae drop to the ground and burrows about an inch into the soil before spinning a cocoon. When you order the midge, it is generally shipped as a red-orange pupa. Place the pupal casing on the soil of plants that have aphid populations. If aphid populations are extremely high, apply either 2 percent horticultural oil or 2 percent insecticidal soap 1 or 2 days before you release the midges. The release rate for low aphid populations is 1 midge per 10 square feet. For higher infestations of aphids release them at 1 midge per 5 square feet of growing area.

Chemical control of aphids. Horticultural oils, insecticidal soaps, and neem are three biorational chemicals that suppress aphid populations. Biorational chemicals are materials that have short residuals and minimal impact on beneficial insects and nontarget organisms. Because these chemicals have no long-term residual effects, regular monitoring of aphid populations is recommended and repeated applications of the chemicals may be necessary.

Two systemic insecticides that give good control of aphids are acephate (Orthene) and midicloprid (Merit). Once a systemic has dried and been absorbed by the plant, the effect on beneficial arthropods is minimal.

Cyclamen mites

The cyclamen mite, Phytonemus pallidus, can cause injury to larkspur. The feeding damage is exhibited in buds and flowers that are distorted and often stunted. Leaf buds of badly infested plants are sometimes completely destroyed. Adult and larva of cyclamen mite occur in hidden areas on the plant. They appear to avoid direct light and require humidity levels near saturation, which is found between tightly packed young leaves, or around flower buds.

Cyclamen mites are minute (less than 0.2 mm). Often a grower will notice damage caused by these mites before actually seeing them. A pocket magnifier microscope with at least 30 X is needed to see the mites. The outer cuticle is hard and shiny and there are relatively few setae (hairs) on the body compared to other plant-damaging mites.

Female cyclamen mites lay eggs in clusters of two to three eggs, usually between young leaves of the bud or at the crown of the plant. Each female lays 10 to 40 eggs over a 12- to 16-day life cycle. Eggs are white, ovoid, and smooth. The larva is white in color, and has six legs with microscopic claws and suction cups. Adult females are yellowish and have eight legs. The males are often colorless to yellowish-brown. Males often pick up and transport females transforming into adults or adult females with their semi-erect hind legs. Female cyclamen mites can reproduce without mating (parthenogenetically).

The cyclamen mite is very difficult to control since its habitat is in tight, confined parts of the plant. Early detection of damage symptoms and subsequent destruction of infested plants is the best course of action cut flower growers can take.

Biological control of cyclamen mites. Neoseiulus (=Amblyseius) cucumeris (Oudemans) is a commercially available mite that is used mainly to control first and second instar thrips, but this phytoseid mite also will feed on cyclamen mites. N. cucumeris has successfully been used to control cyclamen mite on strawberries, but additional field research needs to be conducted on use of this predaceous mite in cut flower fields.
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Several management practices will reduce Southern blight. Deep tillage buries the sclerotia and will reduce the disease because the sclerotia require warmth and oxygen to grow. Incorporating organic matter will help by promoting decay of the sclerotia during the fall, winter, and spring. Wilting plants should be promptly removed along with any mycelium and sclerotia to reduce further increase in fungal inoculum in the field. Fungicide controls and biological agents that decay the sclerotia are in development and may soon be widely registered.

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Before you attempt to control aphids you need to identify the species of aphid. Samples can be submitted to your local Cooperative Extension office for identification. Next, familiarize yourself with the biology of the aphid in a particular crop. Note how fast they reproduce; whether they have a preference for feeding on only certain parts of the plant, or a preference for feeding on certain species or cultivars of plants. One species of aphid that is commonly found on larkspur is the green peach aphid, Myzus persica. This aphid species is very difficult to control with chemical applications.

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Another option for weed control is to use organic mulch as a surface application. If seeding is done in the fall, a 1-inch organic mulch layer (composted leaves or grass clippings) can be applied close to the plants after they germinate. The mulch layer will reduce germination of fall-germinating weeds. In the spring, if the organic mulch layer has thinned out, an additional 1-inch layer can be placed on the soil to reduce germination of spring-germinating weeds.

Glymphosphate (sold under several brand names, including Round-up) can provide postemergent control of grasses and broadleaf weeds. Apply a 33 percent Glyphosphate solution with a wick applicator. Use extreme caution with this solution. Be careful not to make contact with the larkspur or the Glyphosphate will kill your desired plants as well as the weeds.

Some growers have used methyl bromide to fumigate the soil before direct seeding of larkspur. Used for years, this soil fumigant kills weeds, seeds, and many insect and disease species. It is presently still available for use by certified pesticide applicators, but is being phased out of the market because it is extremely toxic. Basamid (granular formulation) can also be used as a soil fumigant and is much safer than methyl bromide.

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Botrytis produces a small, defined spot that may rapidly enlarge to blight the flower, leaf, or stem. Weak plant tissues such as yellowing senescent foliage, flower petals, and wounds are easily invaded by Botrytis. Under humid conditions a gray mold is produced on blighted tissues. This gray mold is diagnostic of Botrytis. Look for this aerial gray mold early in the morning or incubate damaged tissues in a moist chamber overnight to promote the formation of spores.

The Botryt is fungus has developed resistance to several major classes of chemical fungicides, including the benzimidazoles (e.g., Cleave’s 3336 and Domain) and the dicarboximides (Chicpo 26019), making chemical control difficult. When extreme periods of wet overcast weather occur, it may be helpful to spray with mancozeb or use Exotherm Termil smoke in the greenhouse. The copper fungicide Phytion 27 is also registered for Botrytis control on flowers.

**Powdery mildew**
Some larkspur cultivars are susceptible to powdery mildew caused by the fungus *Erysiphe polygoni*. Symptoms include twisted and distorted foliage and white spots and patches on foliage, stems, and buds. Flower buds may fail to open and flowers may be distorted and unsalable. Weather conditions that favor powdery mildew are sunny, warm, dry days, and cool nights.

Several systemic fungicides (e.g., Funginex, Terraguard, Strike, Banner) and summer oil sprays all provide good control of powdery mildew. Some larkspur cultivars are less susceptible. Keep good records of disease incidence on each cultivar you grow; you can then select resistant cultivars.

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Cultivars

• *Consolida orientalis*:
  
  **Giant Imperial series**—The standard of the industry. Plants grow 3 to 4 feet tall. Colors: carmine, deep blue, deep rose, light blue, lilac, pink, salmon, and white.
  
  **Messenger series**—Plants are 3 to 4 feet tall and flower 2 weeks earlier than the Giant Imperial series. Colors: blue, lilac, rose, and white.
  
  **Early Bird series**—Earlybird flowers 2 to 3 weeks earlier than Giant Imperial. Plants are 3 to 4 feet tall. Colors: blue, lilac, rose, white, and mixed.
  
  **QIS series**—Very uniform plants and thick stems. Plants grow 2 to 3 feet tall. Colors: carmine, dark blue, light pink, lilac, rose, white, and mixed.

Pests

**Major Diseases**

The most important diseases of larkspur cut flower production are damping off of seedlings (*Pythium* and *Rhizoctonia* fungi), Botrytis, powdery mildew, and Southern blight.

**Damping off and seedling root rots**

Several species of the water mold *Pythium* attack larkspur seedlings. Both cool and warm temperature species are reported. Wet conditions favor *Pythium* diseases. *Pythium* may rot the germinating seed (preemergence damping off), or cause root rot that stunts or kills seedlings (postemergence damping off). *Pythium* produces a tan, water-soaked appearance in roots and stem. The root cortex may slough off leaving the white root vascular cylinder exposed, like fine white threads.

Blooms have fully opened. If shipping the flowers, try to harvest before the lower one-third of the flower stem has opened. For direct markets, you may choose to harvest when one-half to three-quarters of the flower stem has opened. The vase life of larkspur is between 5 to 7 days. The flower blooms are highly sensitive to ethylene and will shatter in its presence. To hold larkspur for 1 to 2 days, place stems in fresh water, keeping them upright and maintaining temperatures of 34 to 40 °F.

**Everlasting sales**

Larkspur are relatively easy to dry for sale as everlasting flowers. For everlasting flowers, harvest when the majority of the flowers have opened, but before the bottom flower petals have dropped. The feathery foliage does not need to be removed when drying the flower stems. Air dry the flowers by hanging flower stems upside down and drying at 70 to 80 °F for 10 to 14 days. A well-ventilated drying barn is ideal for preserving larkspur.

**Postproduction Factors**

**Retail handling**

• **Recut stems.** After bringing larkspur in from the field, recut stems underwater to prevent a water uptake blockage.

• **Ethylene.** Flowers are highly sensitive to ethylene, with resulting premature dropping of flowers. Flowers will react when exposed to ethylene at 3 ppm for 24 hours at 70 °F. Causes include shipping with mixed-fruit or decaying plant material.
• Pretreatment. Pulse with silver thiosulfate (STS) to minimize ethylene damage and prolong vase life. Use a commercial silver solution according to label directions, preferably for a 1- to 2-hour treatment. The STS solution must be processed for silver recovery before it can be disposed of down a drain. Commercial devices, such as a Superbatcher, are specially designed to remove the silver from STS. STS is not very stable, giving the solution a relatively short shelf life. Unfortunately, it is not always easy to determine whether your STS solution is still active. Test kits are available to test the solution’s effectiveness.

• Hydration. Hydrate in clean, warm water (80 to 90 °F) at pH 3.5 to 4.0.

• Preservation. Use a floral preservative for maximum longevity.

• Temperature. Refrigerate at 35 to 40 °F.

Site selection

Select a location that receives at least 8 hours of direct sunlight. A source of water near the site is good because an irrigation system is frequently needed for best quality production. Larkspur grows best in well-drained soil with a pH of 6.0 to 7.0. Using a raised bed improves drainage and will also warm the bed earlier in the spring. Wide spacing of 10 to 12 inches between plants will provide more cut flower stems per plant. The yield per square foot will increase with a closer spacing of 4 to 5 inches between plants, but will decrease per individual plant.

Support

Most larkspur cultivars grow to a height of 3 to 4 feet. Unsupported flowers will often fall over with the stems turning upward. To maintain the quality of cut flowers, one or two layers of net or wire support (6- to 8-inch openings) are recommended to help hold flowers upright.

Irrigation

Installing a trickle irrigation system is a worthwhile investment. Irrigation is best achieved using irrigation rowcrop tape or rowcrop emitter tubing that lies down the row with emitters spaced 6 to 12 inches apart. Two or three rowcrop tapes on a raised bed will water several rows of plants across the bed. Coarse soils need more tapes. Water frequently enough to maintain a good soil moisture. Use a screen filter of 100 to 140 mesh to prevent clogging and use a small pressure regulating device set at 8 to 10 psi to ensure the proper operating pressure for the trickle tubing. Tensiometers are devices that monitor soil moisture and can be used to help the grower decide when to irrigate. (For more information, refer to University of Maryland Extension Service Bulletin 312, “Soil Moisture Sensors for Irrigation Management.”)

Nutrition

Adding a 1- to 2-inch layer of composted organic material and tilling it in will greatly benefit larkspur growth. Larkspur plants also respond favorably to applications of nitrogen fertilizer. If using trickle irrigation, fertilize on a weekly basis with 100 parts per million (ppm) of complete fertilizer based on nitrogen. Water-driven fertilizer injectors are available that add the correct proportion of concentrated soluble into the irrigation water. If producing larkspur without trickle irrigation, side dress with a complete fertilizer (10-5-10 or 10-6-4 ratio) at 1 pound per 100 square feet of production row.

Greenhouse Production

Larkspur is best grown in groundbeds to facilitate production and harvesting. The seeds should be sown from September through November. Maintain temperatures at 50 to 55 °F for 8 to 10 weeks. Raise temperatures to 55 to 60 °F after this time. Larkspur needs day lengths of 16 hours to flower. The day length can be extended with lighting or with 2-hour night break lighting using incandescent lamps.

Nutrition

Greenhouse-grown larkspur needs weekly applications of a dilute soluble complete fertilizer (for example, 20-10-20 or 15-5-15 ratio) at 100-200 ppm based on nitrogen.
established in the fall grow rapidly in cool, moist springs, with heavy flower production in May and June and occasionally into July if the weather remains favorable.

The genus of larkspur was recently changed from *Delphinium* to *Consolida*. Two species of larkspur are used for cut flowers: *Consolida ambigua* and *Consolida orientalis*. *C. orientalis* is more upright than *C. ambigua*, and colors are often shades of bright pink and purple. *C. ambigua* have more branches initially and colors are usually light pink or blue. Most of the outstanding larkspurs for cut flower production are *C. orientalis* varieties.

**Culture**

**Field Production**

**Propagation**

Larkspur is commonly produced by direct seeding into the field. Some growers start or purchase seedlings grown in greenhouse plug trays, and transplant larkspur plugs into the field or greenhouse growing beds.

Larkspur has a reputation for poor germination. Seeds that germinate best are those planted 4 to 6 months after harvest. Seed 1 year or older often has germination rates of less than 50 percent. Stored seed should be refrigerated until needed, but held for under 1 year. An ounce of seed yields approximately 5,000 plants.

Larkspur seed does not germinate well when soil temperatures are held above 75 °F. Germination will be improved by chilling seed (35 to 40 °F) for at least 7 to 14 days prior to planting. In Maryland, optimum seeding times for field production are from September through heavy frost. Most growers will plant a series of sequence plantings at 2-week intervals. Germination takes place 12 to 20 days after sowing. Once the seed has germinated, the larkspur plants will grow rapidly in cool fall weather. Larkspur plants planted in fall flower 4 to 6 months after planting.

An alternative is to start seeds in a greenhouse during the winter and transplant the plugs in early spring. For greenhouse growing, use a germination temperature of 70 °F, with a light covering of coarse vermiculite. Transplants from the greenhouse should be conditioned at tempera-

**Consumer Care**

- Recut stems under water and place flowers in clean warm water containing a floral preservative.
- Avoid temperature extremes such as freezing or temperatures over 95 °F.
- Keep flowers away from rapid air movement.
- Avoid keeping flowers near ripening fruit, which emits ethylene.

**Summary**

- Select larkspur cultivars and site.
- For field production, prepare seed beds in the fall and plant a series of sequence plantings at 2-week intervals.
- Grow plants in full sun, preferably in raised beds with trickle irrigation.
- Monitor for aphids and cyclamen mites.
- Monitor for diseased plants and promptly remove those that are infected.
Larkspur, *Consolida* spp., are excellent cut flowers—both for fresh and dried or everlasting markets. Many cut flowers are popular for short periods of time, often attracting public attention for less than 5 years, then fading from demand. The market for good quality larkspur has been strong for many years, past the period of “fad flowers,” and it continues to stay robust. The alluring flower shape, wide range of colors, and appealing foliage all combine to make larkspur a popular, marketable cut flower. The flowers tend to be somewhat fragile and relatively short-lived in the vase (under 7 days), making production for local markets very appealing.

Larkspur grow to their full potential in climates with cool, moist summers. Growers must adopt practices that take advantage of the cooler seasons to successfully grow larkspur during the cool weather of September through heavy frost. Plants...