MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 731

PRODUCTION OF PURPLE CONEFLOWER AS A CUT FLOWER

INTRODUCTION

The purple coneflower, *Echinacea purpurea* L., is a member of the aster family, Asteraceae. It was given its genus name, *Echinacea*, in the late 1700's by Konrad Moench of Germany, after the Greek word *echinos*, for hedgehog, a reference to the row of sharply pointed involucral bracts surrounding the receptacle of the inflorescence. Other common names given to the purple coneflower are hedge coneflower, hedgehog coneflower, black sampson, purple echinacea, and purple rudbeckia. The genus contains only four significant species, all of them native to North America. *E. purpurea*, the main cultivated species, is found in open woodlands and prairies from Virginia and Ohio, south to Georgia and Louisiana. It is hardy throughout zones 3 to 9.

MORPHOLOGY

The lower leaves are 4 to 8 inches long, ovate to broadly lanceolate, coarsely toothed, long-petioled, and dark green. The leaves become smaller, narrower, more nearly sessile and more toothless towards the top of the stem.

Like all members of Asteraceae, the "blooms" of the purple coneflower are actually composed of a multitude of individual flowers gathered together on a common disk or receptacle. The individual daisy-like "flowers" are normally 1 ½ to 3 inches wide, but may be as large as 4 to 5 inches in diam-

eter in some of the cultivars. The "inflorescence" consists of a ring of drooping, petal-like, pistillate but sterile ray flowers surrounding a cone-like disk of closely packed fertile tubular flowers. The ray flowers are pink to wine-red to rich mauve-crimson in color, while the disk flowers are orange and brown to purple-black in color when the purple coneflower is in full bloom. The tips of the petal-like ray flowers are often pale gray. The inflorescence is borne terminally and solitarily atop a 2 ½- to 3-foot-tall stem. The purple coneflower begins blooming in July and August, flowers profusely for 2 weeks, and then blooms sporadically for the rest of the growing season.

The purple coneflower is a sturdy plant that needs no staking. It branches uniformly and grows to a height of 36 to 48 inches tall and 20 to 28 inches wide. Purple coneflower produces stout, stately, erect, branching, and red-suffused, hairy stems that bear the terminal daisy-like flowers. The overall effect of the plant is somewhat coarse.

CULTIVARS IN USE

Abendsonne

This is a German cultivar used by Alan Bloom to produce a number of seedlings. One of the finest selections from this strain is "Robert Bloom." Other seedlings were grown to create the "Bressingham Hybrids," a series with light rose to red flowers.

Alba

A seed-grown cultivar known for its creamy-white petals that contrast well with its greenish to copper-brown cone.

Bravado

A cultivar that produces rose-purple flowers on 28-inch-tall plants.

Bressingham Hybrids

A light rose to red seed-grown strain developed from "Abendsonne."

Bright Star

A free-flowering bright rose-red to maroon strain with 4- to 5-inch-wide, flat rather than drooping, flowers borne on 24- to 36-inch wide plants. It is easily propagated from seed, and performs well in England and the United States. Since there is significant flower color variability in the seed-produced plants, the best plants are produced vegetatively from divisions or stem cuttings. The plant does not propagate well from root cuttings. The cultivar is identified as "Leuchtstern" in European literature.

Crimson Star

A new cultivar introduced from Springbrook Gardens, Mentor, Ohio. It has crimson-red flowers borne on 24- to 30-inch-tall stems.

Magnus

A basal-branching cultivar with rosy to deep-purple, 4 ½-inch-wide, strongly horizontal flowers. The up-to-48-inch-tall plant comes true from seed.

Nana

A dwarf 12-inch tall cultivar with small flowers, that is seldom used for cut flower production.

Robert Bloom

A vigorous, free-branching cultivar with intense cerise to carmine-purple, strongly horizontal, 5- to 8-inch wide flowers with orange centers on 24- to 36-inch tall stems.

The King

A 48- to 60-inch tall plant, with 6- to 8-inch diameter flowers with coral-crimson petals and a maroon to brown center. This cultivar was quite popular in earlier years, but was superseded by "Robert Bloom."

White Luster

A 36-inch tall, prolific bloomer even in dry areas, with warm-white rays which tend to reflex, and an orange-brown cone. Even though it comes true from seed, the cultivar is usually vegetatively propagated, as seed is seldom available. It differs from "Alba" in that it has cleaner white petals and an orange center.

White Swan

A 24- to 36-inch tall cultivar that comes true from seed and is excellent as a cut flower. It is similar to "White Luster," but is only 18 to 22 inches tall. The petals are frequently tinged with green.

OTHER SIGNIFICANT SPECIES

Echinacea angustifolia D.C., is a western United States native of the prairies of Saskatchewan and Minnesota, south to Nebraska and Texas. The entire surface of the plant is covered with silky hairs. The basal leaves are oblong-lanceolate, pubescent, and 5-veined. The upper leaves are sessile and pendulous. The flowers have very narrow, strap-like, pink to rose-purple, and sometimes whitish rays. It is utilized as a medicinal plant. *E. angustifolia* is hardy from zones 2 to 8.

Echinacea pallida (Nutt.) Nutt., the pink or pale coneflower, is native to the prairies of Oklahoma, Kansas, and Missouri, south to Louisiana, Alabama, and Georgia. It has pendulous—3 ½ inches long—pink, rose, or white ray florets and dark green leaves. The lower leaves have long petioles, while the upper leaves are sessile. The pink coneflower is a bold, summer-blooming, 4-foot tall by 18-inch wide plant that is excellent for naturalizing and as a cut flower. It is hardy from zones 4 to 9.

Echinacea paradoxa (Norton) Britt., a prairie native of the Ozark region of central and southwestern Arkansas, is aptly named, for it is the only yellow-flowered purple coneflower. It forms broad upright clumps, with semi-glossy, strap-like foliage. The lanceolate basal leaves have prominent linear veins. The solitary, 3- to 6-inch wide, terminal flowers shoot straight upwards on 3- to 4-foot tall stalks from the center of the clump. The slender drooping ray florets surround a hemispherical chocolate-brown cone. *E. paradoxa* is quite drought tolerant, does not tolerate wet feet, is striking in the landscape, and deserves consideration as a cut flower.

UTILIZATION

Purple coneflower is rather versatile, being at home in the perennial border, and naturalized to wild areas. It is used extensively as a cut flower. The plants can be expected to produce a profitable number of stems for 3 to 5 years.

CULTURAL REQUIREMENTS

Purple coneflower does best in a rich well-drained soil. It prefers full sun and is quite drought resistant, although the flower color is intensified by light shade in hot weather.

ENVIRONMENTAL FACTORS

Echinacea does not need a cold period (vernalization) for flower initiation and development, but stem length and yield are improved when the plants are given at least 6 weeks of temperatures at 40ºF. There is little difference in stem length between northern and southern grown plants. No photoperiod responses are known.

PROPAGATION

SEED

Echinacea purpurea is most commonly started from seed. While the species comes true from seed, few of the cultivars come absolutely true from seed. There are some 8,000 seeds/ounce or 280 seeds/gram. Depending upon the germination percentage, it takes about 10 grams, or ¼ to ⅓ ounce of seed to produce 1,000 plants.

Echinacea purpurea seed germinates with a similar percentage (25 percent to 50 percent) at any time of the year. Stratification at 40ºF for 4 weeks enhances germination. Cover the seeds lightly with medium after sowing, as light inhibits germination. According to the literature, germination takes from 10 to 30 days at 65° to 70ºF. If possible, mist the medium until germination occurs. Cooler germination temperatures result in slower, less uniform germination.

Rapidly germinating seeds are ready to transplant 20 to 28 days after sowing. Grow the seedlings on at no less than 50ºF unless the plants are growing too fast. The species may take 2 to 3 years to bloom from seed. Most of the named varieties, and sometimes the species, will bloom during the first summer if the seed is sown in winter. Transplant January-sown seedlings to cell packs to obtain some growth, and then, move them to 4-inch or quart containers. They will be ready to set out in the field by May. Sow the seeds in the greenhouse in December, or purchase plugs to have well-rooted quart or gallon-size plants to set out in early spring.

CUTTINGS

Take 1 to 3-inch long, healthy, basal root cuttings in early spring. Stick the cuttings vertically in a loose, warm, 60/40, volume/volume, mixture of sand and peat. Keep the medium moist but not wet. Rooting will take place and new shoots will appear in 2 to 3 weeks.

Alternatively, lay the root cuttings flat on the surface of the medium and barely cover them with medium. Set the largest plantlets out directly in the field. Place the smaller propagules in pots or cell packs and grow them on to market size in the greenhouse or cold frames.

DIVISION

Divide mature clumps of *Echinacea* every 3 to 4 years. A good time for division is in spring as new growth starts, or during the fall, in September. Set the largest divisions out directly in the field. Place the smaller divisions in pots or cell packs and grow them on in the greenhouse or in cold frames.

GROWING ON

If the seedlings were grown in plug trays, grow them on in full sun for 4 to 6 weeks at 60° to 65°F before transplanting them to cell packs, 4-inch pots, or the field. Fertilize them with 50-100 ppm N constant feed utilizing a complete water-soluble fertilizer such as a 20-10-20 or 15-15-15. If the young plants were grown as seedlings in a tray, transplant the cell packs as soon as they can be handled without damage. This is usually 3 to 4 weeks after sowing.

Space the plants 15 inches apart in rows, or on a 15 by 15 inch spacing in wide-row beds. The centers of the plants are predisposed to disease if the plants are spaced closer than 15 inches apart. The plants may require support if they are spaced greater than 24 inches apart.

Trickle irrigation should be used in the field. Use a heavy-walled "trickle hose," one that looks more like a polyethylene pipe, rather than the typical rowcrop tape or tubing. The heavy-walled trickle hose can withstand the greater mechanical activity that occurs around perennial plants and can be easily moved from one site to another. The emitters are inserted into the hose during manufacture.

Run one trickle hose down each row. Use 2 or 3 trickle hoses for wide row beds. Very coarse well-drained soils will need more tapes than finer, water-retentive soils. Use a screen filter with 100 to 140 mesh to prevent clogging of the irrigation lines and a small pressure regulating device set at 8 to 10 psi to ensure proper operating pressure for the trickle irrigation. Use tensiometers, devices that monitor soil moisture, to help decide when to irrigate. Water frequently enough to keep the soil moist but not wet. Contact Maryland Cooperative Extension for more information on trickle irrigation.

Purple coneflowers are not heavy feeders. They should be fertilized steadily but lightly to maintain plant vigor. A water-driven proportional injector can be used to supply fertilizer through the trickle irrigation system. Apply 200 ppm N once a week using a complete fertilizer formulation such as a 20-10-20 or a 15-5-15. Alternatively, apply 1 pound of a complete dry fertilizer such as a 10-5-10 or 10-6-4 per 100 square feet of production area in lieu of a water soluble fertilizer. Fertilize established plants with a dry fertilizer the first time in late March to early April right before growth starts. Fertilize twice more at 6-week intervals as the season progresses. Fertilize new plants with a dry fertilizer twice during the growing season, the first time about 6 weeks after the plants are established and again 6 weeks later.

INSECTS

Purple coneflowers are subject to infestation by many insects. Among the most damaging are aphids, garden fleahoppers, and aster leaf hoppers.

Aphids

Several species of aphids have been reported as attacking *Echinacea*, including, *Dactynotus ambrosiae* (Thomas), Brown ambrosia aphid, *Aphis gossypii* Glover, melon aphid, and *Myzus persicae* (Sulzer), green peach aphid. All aphids are pear-shaped, have long antennae, and have a pair of tailpipe-like tubes, or cornicles, projecting from the rear of their abdomens. Aphids feed by inserting their needle-like feeding stylets into the phloem tubes of leaves and stems and ingesting the fluid. When excessive amounts of sap are ingested, it is excreted as a sugary fluid that coats the leaves and stems. Under humid conditions, sooty mold fungus often grows on the sap, creating an unattractive black stain. Aphids reproduce parthenogenetically, without sex, with as little as 1 week between successive generations of virgin females. This leads to a massive population of aphids in a brief time. Aphids damage plants by causing wilting, dieback of stems, and discoloration and distortion of foliage. They also transmit several plant viruses.

Brown ambrosia aphids are large, dark blood-red aphids that infest plants in the

family Compositae and Campanulaceae, including *Echinacea*. Melon aphids have been reported feeding on over 25 plant families. Melon aphids vary from pale green to dark green but the short cornicles are completely dark. For melon aphids there are two kinds of host, primary and secondary. In the late fall, aphids feed upon primary plants, mate, and lay overwintering eggs. In the spring, winged forms infest new plants, both primary and secondary, and the females produce live nymphs. Within a week the new nymphs mature into wingless females that begin to bear young of their own. As plants become more crowded, increasing numbers of offspring develop into winged females which migrate to new plants.

The green peach aphid is light to dark green or pink with red eyes. Three dark lines run down the back. There is a distinct indentation on the head capsule between the antennal bases. Green peach aphid has been collected from over 100 species of plants, including *Echinacea*. The reproductive ability of green peach aphid is incredible. High reproductive rates and a tendency to develop resistance to pesticide applications make this aphid a formidable pest. Growers should monitor regularly for this aphid and treat while populations are still low.

Close monitoring of plants will alert growers to the presence of aphids. Aphids can be controlled in several ways when they are detected. The first line of defense in field or greenhouse production is to eliminate all weeds that may act as hosts for aphids. Microscreening will help keep the winged adult aphids out of the greenhouse. Low populations of aphids may be controlled with releases of the beneficial midge, *Aphidoletes aphidimyza*, especially for the green peach aphid. Among the biorational materials that may be used on aphids are insecticidal soap (**M-Pede**) and horticultural oils (**UltraFine SunSpray spray oil and JMS Stylet oil**). Botanical insecticides include neem (**Azatin and Margosan-O**) and natural pyrethrums. Immature aphids are readily controlled in greenhouses with insect growth regulators such as Kinoprene (**Enstar II**) and Fenoxycarb (**Precision**). The systemic insecticide acephate (**Orthene**) gives effective control. Once it has dried, it is found only inside the plant and does not harm beneficial organisms. Imidacloprid (**Marathon for greenhouse use and Merit for use in field produced flowers**) is a systemic insecticide that gives good control of most aphid species.

Garden Fleahoppers

Halticus bractatus (Say), garden fleahoppers, nymphs are pale yellow to dark green and range from 0.7 to 2 mm in length. All nymphal stages have a jumping habit. The later instar have a distinct black spot of the first thoracic segment.

The adult garden fleahopper has three forms: slender, long-winged females; oval-bodied, short-winged females; and slender, long-winged males. All forms are black and have long legs and antennae. They tend to jump actively but are also capable of flying. They suck sap from stems and foliage and may have up to five generations a season. They cause damage by sucking sap from their hosts. The resultant spots may be up to 1/16-inch in diameter, coarse, and may be bleached or dark colored. Leaf distortion, flower drop, and death may occur if the infestation is heavy. In shaded locations whole plants may be severely distorted and die. Because garden fleahoppers overwinter on litter, sanitation is the first line of defense.

Aster Leafhoppers

Macrosteles fascifrons (Stal), aster leafhopper, or sixspotted leafhopper, is greenish yellow, 1/8 inches long, slender, wedge-shaped, and has six black spots on its head. It is especially important to cut flower growers as it transmits a mycoplasma disease, aster yellows, to many ornamentals including purple coneflower. It overwinters on the foliage of flowers and perennial weeds, making sanitation a first line of defense.

The infective mycoplasma is not carried in the egg, and early nymphal stages cannot infect plants, because the period between each of their early molts is shorter than the minimum latent period of 10 to 18 days that the mycoplasma must be carried by the insect before it can be transmitted to plants. With a life cycle of only 40 days during normal summer temperatures, there may be 3 to 4 generations of aster leafhopper each growing season.

DISEASES

Purple coneflower has no serious diseases in the Mid-Atlantic region. Occasionally leaf spots and flower blights may be seen. These problems usually appear following extended periods of wet weather. The plants may be infected by several viruses and by the diseases aster yellows and chrysanthemum stunt, resulting in loss of a few scattered plants.

Leaf and Flower Spots and Blights

Spotting of foliage and petals may be caused by several fungi and bacteria. These diseases start as small spots that gradually become larger. When leaves or flowers have many spots they may be blighted. Several fungi (*Ascochyta* sp., *Phyllostica* sp., *Septoria lepachydis*, and *Cercospora rudbekia*) are reported to infect purple coneflower. *Septoria* usually appears early in the growing season, starting on lower leaves and gradually working up the plant. *Cercospora* is more of a hot weather disease, appearing in midsummer following periods of wet weather.

The fungus *Botrytis cinerea* can also spot foliage and blight flowers. When *Botrytis* is the culprit, the blighted areas will sport the distinctive "gray mold" under humid conditions. Look early in the morning before the dew has dried, or incubate the blighted leaf in a moist chamber overnight.

Occasionally the *Rhizopus* fungus can also blight flowers. *Rhizopus* produces an even more bushy gray mold than *Botrytis*.

Two bacteria (*Pseudomonas cichorii* and *Xanthomonas campestris*) are also reported to cause leaf and flower spots. These bacterial diseases produce spots that often have a water-soaked yellow margin. This symptom can be more easily seen by observing the spots backlit by a strong light (sunlight is good) to reveal the translucent margin of each spot.

Virus, Viroid and Phytoplasma Diseases

Occasionally, scattered plants may exhibit symptoms of foliar mosaic, leaf and flower malformations or stunting. These symptoms could be caused by virus, viroid or phytoplasma. The disease aster yellows (phytoplasma) and chrysanthemum stunt (viroid) are reported but are not common. Mosaic symptoms are attributed to a virus, but the virus has not been identified. The best control for these diseases is to promptly rogue out symptomatic plants. Take care not to propagate from plants that show symptoms of foliar mosaic, stunting or flower malformations (green petals, twisted flowers, etc.) Bear in mind that some herbicides can also produce similar symptoms, so if many plants suddenly show these symptoms at the same time in the field, suspect a chemical rather than disease.

Disease Management

Several cultural practices can greatly reduce loses from disease. These are sanitation, use of trickle irrigation and proper plant spacing.

The term sanitation encompasses a variety of practices aimed at preventing introduction of disease agents into fields and reducing the spread of those that are omnipresent such as *Botrytis*. Start with healthy plants that do not show disease symptoms such as rotting roots, leaf spots, etc. During the growing season, remove spent flowers and any diseased-looking plant parts. Fungi and bacteria produce more infective material such as spores and bacterial ooze on the spots. Air currents and splashing water spread the infective materials to healthy plant parts. At the end of the growing season, after the first hard frost, cut the plants back to the ground and remove the old stems and foliage. This material may be safely composted. The disease agents (fungi, bacteria) remain over the winter in undecomposed stems and leaves. Virus, viroid and phytoplasma diseases are not common. Plants thought to be infected by these agents should be promptly rogued out of the field so they cannot serve as a source of infection to the rest of the crop.

All of the fungal and bacterial diseases mentioned are promoted by extended periods of leaf wetness. Use trickle irrigation, or if overhead irrigation must be used, water early in the day so that plant surfaces may dry before evening, to reduce spread and severity of these diseases. Space plants so that air circulates and promotes drying of foliage following rain, irrigation, or heavy dews.

WEEDS

Weed control is one of the most important aspects of raising cut flowers. Weeds compete with cut flowers for water, nutrients, and root space, thereby devaluing the quantity and quality of the yield. They often serve as hosts for insect populations that may migrate to cut flowers. The insects that move from weeds to cut flowers may bring diseases with them. Thus, weed management is critical to cut flower production.

Weed management consists of an integrated approach involving organic and inorganic mulches, preemergent herbicides, cultivation, cover crops, and sanitation. It is important to know the life cycle of the weeds to effectively eradicate them. Weeds may be summer annuals that germinate in spring and flower and set seed by fall, winter annuals that germinate at the end of the growing season and overwinter as dormant plants, biennials which germinate by midseason and overwinter before blooming and bearing seed, and perennials that survive for more than two growing seasons and propagate by seed or vegetative means.

Mulches inhibit the germination of weeds by providing a barrier to germination. They also moderate soil temperature fluctuations, reduce water loss, keep mud from spattering flowers and foliage, and if organic, provide nutrients when they are incorporated into the soil and biodegrade. It is important that any mulch, whether organic or inorganic, allow a free exchange of atmospheric gases and percolation of water.

Cultivation should always be shallow, to avoid root injury. Injury to the root system not only decreases the plant's ability to absorb nutrients and water, it also may act as the entry point for insects and disease. If the weeds are few, scattered, and easily pulled, hand weeding is a viable option for weed control in small operations.

Chemical control consists of preemergent and postemergent herbicides. Preemergent herbicides are applied before weeds emerge and usually give residual control for several weeks after application. Postemergent herbicides are applied after the weeds emerge and may be contact herbicides, killing only the portion of the plant that is sprayed by the herbicide, or systemic herbicides, which are absorbed and move throughout the plant, killing the entire plant, roots and all, even though the whole plant is not sprayed. Systemic herbicides are particularly useful with weeds that have creeping roots and rhizomes. They are effective only if the weed is actively growing. Those postemergent herbicides registered for use with cut flowers are nonresidual and have little, if any, soil activity.

Among the preemergent herbicides registered for use on purple coneflower are *DCPA* or *chlorthal-dimethyl* (**Dacthal & many other trade names**), *pendimethalin* (**Pendulum, Southern Weed Grass Control, Lesco Pre-M**) and *oryzalin* (**Surflan**). The only postemergent herbicide registered for use on purple coneflower is f*enoxaprop* (**Acclaim**). Acclaim gives selective postemergence control of annual and perennial grasses.

HARVEST

Harvest the flowers when the petals are expanding if the flowers are to be sold fresh. Leave the flowers on the plants longer to color the disk and allow easier removal of the petals if the flowers are to be used as dried, disk flowers.

POST HARVEST

Fresh: Petals of the wild species, but not most of the cultivars, tend to droop regardless of the time of harvest and detract from the beauty of the flowers. Customers tend to think that the flowers are wilting, even though they are not. Place the cut stems in floral preservative and store the flowers at 40°F. Flowers last from 7 to 10 days in preservative solutions.

Dried: Remove the petals and hang the flowers upside down to dry when the flowers are grown for their disk only. Dried *Echinacea* disks last virtually forever.

SUMMARY

- Select cultivars to be grown.
- Grow seedlings or plugs to transplantable size.
- Space plants on at least a 15 x 15 inch spacing.
- Water and feed as needed.
- Grow plants to maturity.
- Monitor for insects, diseases, and weeds.
- Harvest blooms as petals, enlarge for fresh market.
- Let blooms mature fully for dried market.
- Place cut stems in preservative solution at 40°F.

BIBLIOGRAPHY

Armitage, A. M. 1993. *Specialty Cut Flowers: The Production of Annuals, Perennials, Bulbs, and Woody Plants for Fresh and Dried Cut Flowers*. Portland, OR: Variety Press, Inc./Timber Press.

Armitage, A. M. 1989. *Herbaceous Perennial Plants: A Treatise on Their identification, Culture, and Garden Attributes*. Athens, GA: Varsity Press, Inc.

Chase, A. R., M. Daughtery, and G. W. Simone. 1995. *Diseases of Annuals and Perennials*. Batavia, IL: Ball Publishing.

Daughtery, M. and M. Semel. 1987. *Herbaceous Perennials: Diseases and Insect Pests*. Ithaca, NY: Cornell University.

Everett, T. H. 1981. *The New York Botanical Garden Encyclopedia of Horticulture*. New York: Garland Publishing Co.

Hausbeck, M. K. 1994. *Control of Diseases on Commercial Outdoor Flowers*. North Central Extension Publication #491.

Horst, K. R. 1990. *Wescott's Plant Disease Book*. New York: Van Nostrand Reinhold.

Huxley, A. Editor in Chief. 1992. *The New Royal Horticulture Society Dictionary of Gardening*. London: The Macmillan Press Limited.

Jelitto, L. and W. Schacht. 1990. *Hardy Herbaceous Perennials*. Portland, OR: Timber Press.

Nau, J. 1993. *Ball Culture Guide: Encyclopedia of Seed Germination*. Batavia, IL: Ball Publishing.

Nau, J. 1996. *Ball Perennial Manual Propagation and Production*. Batavia, IL: Ball Publishing.

Nowak, J. and R. M. Rudnicki. 1990. *Postharvest Handling and Storage of Cut Flowers, Florist Greens, and Potted Plants*. Portland, OR: Timber Press.

Powell, C. C. and R. K. Lindquist. 1992. *Ball Pest & Disease Manual*. Geneva, IL: Ball Publishing.

Ross, D.S. 1987. *Irrigation for Cut Flower Production*. Agricultural Engineering Fact Sheet 162. College Park, MD: University of Maryland Cooperative Extension Service.

Senesac, A. and J. Neal. 1995. *Weed Facts, Weed Management series No. 1, Weed Management Guide for Herbaceous Ornamentals*. Ithaca, NY: Cooperative Extension, Cornell University.

Still, S. M. 1994. *Manual of Herbaceous Ornamental Plants*. Champaign, IL: Stipes Publishing.

Westcott, C. 1973. *The Gardener's Bug Book*. Garden City, NY: Doubleday & Company.

Vaughn, M. J. 1988. *The Complete Book of Cut Flower Care*. Portland, OR: Timber Press.

Production of Purple Coneflower as a Cut Flower

by

Russell Balge
regional Extension specialist
Western Maryland Research and Education Center

Bryan Butler
faculty Extension assistant
Carroll County

Stanton Gill
regional Extension specialist
Central Maryland Research and Education Center

Ginny Rosenkranz
faculty Extension assistant
Wicomico and Worchester Counties

Ethel Dutky
plant pathologist
Department of Entomology
University of Maryland, College Park

Suzanne Klick
commercial horticulture technician
Central Maryland Research and Education Center

Tom Blessington
regional Extension specialist
Central Maryland Education and Research Center

Illustrations by
Raymond V. Bosmans,
regional Extension specialist
CES Home and Garden Information Center

David Ross
Extension agricultural engineer
Department of Biological Resources Engineering
University of Maryland, College Park

Reviewed by
Dr. Richard McAvoy, University of Connecticut
Dr. Lois Berg Stack, University of Maine

P99

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Thomas A. Fretz, Director of Maryland Cooperative Extension, University of Maryland.