ENH1020

UF UNIVERSITY of FLORIDA
IFAS Extension

Seed Production of Annual Phlox[1]

Jeffrey G. Norcini and James H. Aldrich[2]

Species Description

Phlox drummondii Hooker, commonly known as annual or Drummond phlox is one of north and central Florida's showiest and most reliable spring flowering annuals. It is native to the U.S. but there are some who do not consider it native to Florida. There's little dispute, however, about its showiness. Year after year, regardless of the weather, annual phlox graces Florida roadsides (Figure 1) and fields (Figure 2) with an array of mainly pink to purple flowers, with the occassional red and white mixed in. Roadside stands of all red flowering phlox are sometimes planted by local or state transportation agencies.

This spreading plant can grow about 1 1/2 feet tall and 2 feet wide, especially under cultivated conditions. It grows best under full sun and in sandy soils. Flowering usually begins in April in central Florida and by late April or May in north Florida.

Annual phlox is pollinated by butterflies (4), including the monarch (*Danaus plexippus*), black swallowtail (*Papilio polyxenes*), clouded sulphur (*Colias philodice*), and cabbage white (*Pieris rapae*).

Figure 1. Naturally occuring stand of annual phlox in Marion County, Florida in late April.

Seed Origin

Regardless of whether annual phlox is native to Florida, naturally-occuring populations in north and central Florida have likely existed for many years, and over those years have adapted to our climate through a process of natural selection. Seed originating from these naturally-occurring populations—plants that growers, breeders, etc. have not subjected to a process of artificial selection for

1. This document is ENH 1020, one of a series of the Environmental Horticulture Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date December 23, 2005. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.

2. Associate Professor, native wildflower specialist, and Senior Biological Scientist, North Florida Research & Education Center, Quincy, FL 32351.

Figure 2. Natural stand of annual phlox flowering in a Madsion County field in mid-May.

desirable traits—is commonly referred to as Florida ecotype, Yellow Tag, or Source Identified (see also **Seed Testing and Certification**). To receive this designation, the grower must have the seed crop certified as to the Florida county of the original, naturally-occurring population(s). Given the range of annual phlox in Florida, there are potentially many ecotypes that could be produced.

Florida ecotype seed commands a high price because plants derived from this seed should perform better in noncultivated sites—like roadsides, meadows, and natural areas—than plants derived from other regions of the country. Since these plants are adapted to our conditions, the current thinking among many in the scientific community is that Florida ecotypes should be grown in Florida.

Two excellent articles that address the issue of seed origin in detail are "Genetic Principles and the Use of Native seeds -- Just the FAQs, Please, Just the FAQs" (2) and "Native Seeds in Commerce: More Frequently Asked Questions" (3).

Establishment and Maintenance

Grow annual phlox in a landscape fabric system (Figure 3). Yields as high as 60 to 80 lb per acre have been reported for landscape fabric production systems (Joe Melton, personal comm.) but yields were only up to 6 1/2 lb per acre for field crops (Steve and Joe Melton, personal comm.). The wide disparity in yields is because only a small percentage of the seed are ripe at any one time, and secondly, ripe capsules are explosively dehiscent. That is, the capsule opens abruptly and seed is ejected when the seed inside the capsule have matured and the capsule has reached a certain level of dryness. The landscape fabric system allows for easy capture of dispersed seed.

In the landscape fabric system, plants are grown in narrow rows created by a 2- to 4-inch gap between parallel strips of woven landscape fabric. Plastic film is discouraged because it will limit rain from reaching the roots. Also, rain water could pool on the plastic and wash seed away. While plastic is less expensive than woven fabric, plastic might only last 1 year whereas fabric could last 5 to 7 years.

Figure 3. Annual phlox seed crop being grown in a multi-species landscape fabric system.

Site Selection

Select a site in full sun that has a well-drained, slightly acid soil. Such a site should be chosen with the goal of minimizing weed growth. For more information about weeds, see **Weed Control**. It is also important to identify weeds in and around the site prior to planting so that you know what weed problems might be encountered and can plan on practices to control them. To minimize weed growth:

- Choose a site with a sparse weed population. At sites where weed growth is dense, there is probably a substantial weed seed bank in the top 2 to 3 inches of soil. Inhibiting germination and growth of weeds at sites that strongly support their presence could be costly or futile. However, sparse weed growth could be due to extremely compacted soil.

- Avoid sites with heavily compacted soils as well since making these sites suitable for production could be costly.

- Avoid sites with a considerable amount of yellow or purple nutgrass (*Cyperus esculentus* and *Cyperus rotundus*, respectively). Theses sedges can spread rapidly, are extremely competitive, and are difficult to eliminate.

- If the site is in turf, choose an area where the turf cover is thin or moderate. Avoid areas of thick turf. While grass herbicides can help control grasses, site conditions that support thick turf would probably favor weed growth as well. The best site would be one primarily with sparse growth of bahiagrass and few to no broadleaf weeds or nutgrasses.

Site Preparation

Most aspects of site preparaton are the same whether establishing the production plot by seed or transplants.

Minimum Till. About 4 weeks before planting, kill existing vegetation with a nonselective, translocated herbicide that contains either glyphosate or glufosinate as the only active ingredient. More than one application will probably be needed to kill the weeds so make the second application about 2 weeks after the first application. About 2 weeks after the second application, mow the dead vegetation close to the soil and either bag the clippings, direct the mower discharge so that clippings are discharged off the planting site, or if permitted, burn off the dead vegetation.

Seed. Delineate the row locations and then lightly disk or harrow the rows only. If the soil is loose, only lightly roll or cultipack the rows. The soil should not be too firm (see **Planting, Seed**).

Transplants. No further site preparation is necessary, unless irrigation will be installed. Irrigation is discussed at the end of this section.

Deep Till. While the minimum till method reduces weed competition by minimizing soil disturbance, the goal of the deep till method is to substantially deplete the weed seed bank in the soil. This method will result in a well tilled soil and minimal weed competition, but it can take up to 2 years to complete.

Existing vegetation is killed with a nonselective, translocated herbicide containing either glyphosate or glufosinate as the only active ingredient. The field is then deep tilled and a new crop of weeds is allowed to emerge. When weed seedlings are 1 to 3 inches tall, kill them as before. Repeat this herbicide/tilling cycle for up to 2 years. Since the soil is deep tilled, it will have to be firmed up as mentioned before.

Soil Solarization. This is a cultural method of pest control in which clear polyethylene is laid over moist, tilled soil for 6 to 12 weeks to trap incoming solar radiation, thereby heating the soil to temperatures lethal to many weed species and soil-borne pests. Several points to keep in mind are:

- Use this method only in summer or early fall.

- This method will only control/suppress soil pests 6 to 8 inches down in soil.

- Soil must be kept moist.

- Some crabgrass species may not be controlled.

Additional information about soil solarization can be found in Florida Cooperative Extension Service publication ENY625, "Nematodes and Their Management" (http://edis.ifas.ufl.edu/CV112).

Once the soil is prepared, consider installing an irrigation system so that plants can be irrigated during extended dry periods. Annual phlox is relatively drought tolerant under natural conditions but it is less so in high density plantings under cultivation. And just as important, water stress may affect seed yield and quality.

Planting

Seed

While seed of spring blooming annuals are typically sown in late summer or early fall, there is preliminary evidence that germination of annual phlox is better when seed is sown in late November or

early December (Norcini and Aldrich, unpublished results). Moreover, sow seed 1/4 to 1/2 inch deep, which is a bit deeper than recommended for other small-seeded species. The greater depth might be beneficial because annual phlox germinates better in the dark than in the light.

Figure 4.a

Figure 4.b

Figure 4. Annual phlox seedlings: a. 11 days old b. Seedlings in early January; seed were sown in mid-October.

Sow about about 1.5 lb Pure Live Seed per acre in a slightly loose soil using a mechanical planter. This rate should yield a stand dense enough to help reduce weed competition. After seed is sown, use a rake to help incorporate the seed into the soil. Then firm up the soil by walking down the row in flat-soled shoes, or lightly roll the row. Best stand establishment will occur with frequent rain or supplemental irrigation for the first 2 to 3 weeks after seed is sown. Seedling growth will be slow until the weather warms up in the spring (Figure 4).

Transplants

Plant seedlings in early October to early November so that they can develop a good root system and harden off before the first frost or freeze. Seedlings to be transplanted should have a well-developed root system but not be root bound. We have noted that seed sown in the greenhouse in late July resulted in seedlings ready for transplanting in early October.

Space plants about 6 inches on center. Seedlings will require frequent irrigation (rain or supplemental irrigation) for the first 2 to 3 weeks after transplanting. Some flowering may occur during late fall or winter but seed set, if any, will be low.

Fertilizer

Currently, there are no IFAS fertilizer recommendations for annual phlox seed production or for any other wildflower seed crop. There is preliminary evidence that supplemental fertilization increases yield (Norcini and Aldrich, unpublished results). However, decisions about fertilization should be based on a soil test, which should be conducted annually to determine levels of phosphorus (P) and potassium (K). If you decide to fertilize, apply a fertilizer with a low N, low to no P, and high K ratio (for example, 5-0-20 or 5-5-20). And consider that excess nitrogen may promote vegetative growth over flower production.

Begin fertilizing in late Februray or early March. Since annual phlox could flower into June under cultivation, adequate soil nutrients need to be available to the crop into July as the seed ripen. If a fertilizer is not used the first year, it's likely that supplemental fertilization will be needed in subsequent years.

A controlled-released fertilizer (CRF) can be used for rows that are more than 3 inches wide in landscape farbric systems. If a drip irrigation sytem has been installed, fertigating will provide more uniform distribution of nutrients to the crop than a CRF.

Irrigation

Use supplemental irrigation to ensure that plants receive at least 1 inch of water per week. However, less frequent irrigation may be needed during cold weather in late fall and winter. When irrigating the crop, apply at least 3/4 inch each time to encourage a deeper root system.

Weed Control

Weeds usually are the major pest problem in wildflower seed crops. They could reduce seed yield by competing with the crop for water and nutrients. And just as important, marketing of the seed will be difficult or impossible if there are too many weed seed mixed in with the crop seed. Be especially thorough when eliminating noxious weed species (1) from your planting. Seed of noxious weed species mixed in with annual phlox seed will severely limit your ability to sell or distribute your seed, and might even prevent it. For example, the Florida Department of Transportation has zero tolerance for noxious weed species in wildflower seed that they purchase.

Weed control is a major consideration when deciding whether to direct seed or use transplants. Direct seeding is much less expensive than using transplants but there are no herbicides currently labelled for use on seed beds used for wildflower seed production. Hence, some costly handweeding will probably be necessary the first year. The advantage of using transplants is that preemergence herbicides can be used soon after transplanting (see **Chemical Weed Control**).

Under good growing conditions, annual phlox will out compete many weeds as the annual phlox fills in the row. However, even if weed competition seems minimal and the crop is thriving, use practices that will reduce the amount of weed seed that could be harvested with the crop seed.

Cultural Practices. In direct-seeded plots, handweeding will be necessary until seedlings are large enough to permit use of a preemergence herbicide or postemergence grass herbicide. Some handweeding might be necessary in transplant plots even if a preemergence herbicide was used. For example, nutgrass (*Cyperus* spp.) often is not controlled and must be removed manually or sprayed with a nonselective postemergence herbicide. Eradicate nutgrasses as soon as possible because they can quickly spread.

Mowing can be used to keep weed growth in check as well but mow weeds before they flower and go to seed. Production plots can be mowed until annual phlox becomes too tall to remain under the blade. Also, mow the area surrounding the seed production area often enough to prevent weeds from flowering.

Chemical Weed Control. If chemical weed control is to be part of the weed management program, use a preemergence herbicide. Preventing weed growth is usually less expensive than killing existing weeds. Pennant Magnum®, Treflan™, Trilin®, and Trilin® 5 (the latter three are different formulations of trifluralin) are preemergence herbicide products currently labelled for use on all *Phlox* species. While these herbicides should be safe to use on annual phlox, herbicide tolerance can vary depending on seed source and growing conditions. Testing these herbicides on a small portion of the planting prior to widespread application would be wise. Check for injury for 1 to 2 months after application.

Grasses growing in or around crop plants can usually be controlled with postemergence application(s) of a grass herbicde. The only postemergence grass herbicide specifically labelled for use on annual phlox is Vantage; Envoy® is labelled for all *Phlox* species. Like the preemergence herbicides mentioned above, these herbicides should be tested on a small portion of the crop prior to widespread application.

Existing annual and perennial broadleaf weeds or nutgrasses can be controlled by directed applications of a nonselective herbicide that contains glyphosate or glufosinate as the only active ingredient. Small or immature weeds can be killed with a directed application of a contact herbicide that contains diquat or an herbicidal soap as the only active ingredient. Whenever applying nonselective or contact herbicides, use a shielded spray nozzle to reduce the likelihood of spray drift damaging the crop.

Whenever using any herbicide, read and follow all label directions, including those for protective safety equipment and re-entry intervals.

Other Pests

Septoria leaf spot (*Septoria drummondii*) is reportedly the only significant leaf spot that occurs on annual phlox in Florida (7). Daconil Ultrex®, Echo® 720 Turf and Ornamental, and Milstop™ are the only three fungicides labelled for control of septoria leaf spot on *Phlox* species. No grower in Florida has reported any diseases that have caused a significant problem to a seed crop.

No significant insect pests have been observed on annual phlox crops.

Figure 5. Mature, unopened capsule of annual phlox. Credits: Photo courtesy of Kent Schwaegerle, University of Alaska Fairbanks.

Stand Longevity

Annual phlox produces an abundance of seed. Since all seed cannot possibly be harvested, replanting should not be necessary. However, to help preserve the genetic diversity of the original planting, store some of the seed used to establish the original crop and re-introduce some of the original seed (or transplants) into the production plots every 2 to 3 years.

Harvesting Seed

Seed are contained in a small, roundish, light brown capsule (Figure 5). There can be up to 3 seed (Figure 6) per capsule, but usually there are only 2

Figure 6. Ripe seed of annual phlox; the yellow bar = 1 mm.

per capsule in wild populations (5), which is the source of seed in Florida's wildflower seed production industry. Shedding of seed will begin in late April and continue into early July in landscape fabric production systems. Vacuum the seed off the fabric several times per week because they could wash away in a storm or be blown away. Black landscape fabric can also get quite hot (over 160°F on a sunny day), so exposure of the seed to this heat needs to be minimized. For small production areas, sweeping up seed with a broom might be efficient as well.

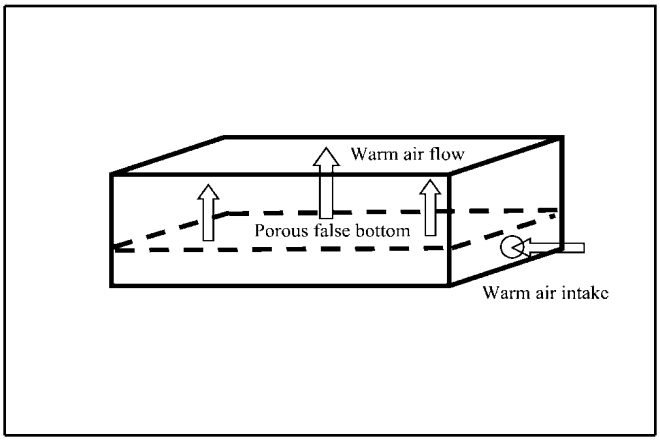

Figure 7. Diagram of a simple seed drying bin.

Postharvest Drying

Seed must be dried before they are cleaned, and just as important, dried relatively quickly. Spread out harvested seed on a clean, hard surface and allow it to dry for a few days before cleaning. Use a floor fan to aid drying if the harvest is large. Laying the

harvested seed on brown packing paper or newspaper in a shed or barn should be adequate. (Visit your local newspaper and ask for the ends of newsprint rolls.) If drying seed outdoors, seed can be blown away in windy weather, and dew and rain will slow the drying process.

An alternative method is to dry the seed in a drying bin (Figure 7). A simple seed drying bin consists of four plywood walls and a porous false bottom, with warm, dry air (<100°F) forced up through the bottom. Some growers use a furnace fan as a source of warm air. Openings in the false bottom need to be small enough that seed do not fall through. Spread out seed evenly (and not too thick) over the entire floor of the bin. If part of the floor is not covered with seed, the air will preferentially flow through that gap and increase drying time.

Cleaning Seed

Annual phlox seed is relatively easy to clean since there is not much plant debris or weed seed to deal with in landscape fabric systems. Use a two-screen (or more) air-screen cleaner to remove most debris and weed seed. After that, a vacuum air density separator can be used to remove empty seed as well as weed seed of similar size but of different density (Steve Melton, personal comm.)

Small quantities of seed can be cleaned by hand with screens used in an air-screen cleaner. Screens can by purchased for about $35 each.

Seed Storage

Store clean seed in a cool, dry environment such as a large refrigerator or walk-in cooler for maximum shelf life. The current rule of thumb is that temperature (°F) + relative humidity (% RH) in the storage facility should total 100 or less. For example, storing seed at 35°F and 40% RH (35+40=75) would be adequate.

If seed is going to be stored in a shed or barn, protect seed against insects and rodents. No matter where the seed is stored, each bag should be labeled with the species name, date of harvest, date of storage, percent purity, and percent germination.

Seed Testing and Certification

Seed must be tested prior to sale. Purity and germination tests must be conducted. A viability test, which is best when conducted independent of the germination test, is strongly recommended. Total cost for these tests is about $90 or more for each wildflower seed lot that will be sold. A viability test is sometimes accepted instead of a germination test because optimal germination conditions for Florida ecotypes of annual phlox may be different than commercial germination protocols for annual phlox. However, Florida state seed law currently requires that germination test results appear on the label.

Labs that specialize in testing native species:

Mid-West Seed Services, Inc.
236 32nd Avenue
Brookings, South Dakota 57006
(877) 692-7611
info@mwseed.com
http://www.mwseed.com

Ransom Seed Laboratory, Inc.
PO Box 300
Carpinteria,CA 93014-0300
(805)684-3427
Ransomsl@silcom.com
http://www.ransomseedlab.com

Some buyers may require that the seed be certified as being Source Identified by the Southern Seed Certification Agency, a joint agency of Florida and Alabama. Certification currently costs $250 per year, regardless of the number of species to be certified, plus $0.10 per pound of seed to be sold.

Southern Seed Certification Association, Inc.
PO Box 2619
Auburn, AL 36831
(334) 844-4995
http://www.ag.auburn.edu/auxiliary/ssca/

Costs

Detailed information about costs is in the Florida Department of Agriculture Publication "Native Wildflower Seed Production in Florida" (6).

References

1. Burks, K.C. 2000. Non-native plant species restricted by federal, state, or local law in Florida. Bureau of Invasive Plant Management, Florida Department of Environmental Protection, Tallahassee, FL. http://www.dep.state.fl.us/lands/invaspec/2ndlevpgs/pdfs/list.pdf

2. Jones, T.A. 2005. Genetic priniples and the use of native seeds -- just the FAQs, please, just the FAQs. Native Plants J. 6:14-24. http://www.nativeplantnetwork.org/Content/Articles/6-1NPJ14-24.pdf

3. Jones, T.A. and S.A. Young. 2005. Native seeds in commerce: More frequently asked questions. Native Plants J. 6:286-293. http://muse.jhu.edu/journals/native_plants_journal/v006/6.3jones.pdf

4. Levin, D. 1969. The effect of corolla color and outline on interspecific pollen flow in *Phlox*. Evol. 23(3):444-455.

5. Levin, D. 1972. The adaptedness of corolla color phases of experimental and natural populations of *Phlox drummondii*. Amer. Nat. 106:57-70.

6. Norcini, J. 2005. Native wildflower seed production in Florida. Florida Dept. of Agric. & Consumer Services, Talla. FL. 16 pp. http://www.florida-agriculture.com/pubs/pubform/pdf/Native_Wildflower_Seed_Production_In_Florida.pdf

7. Schubert, T.S. and J.J. McRitchie. 1985. Septoria leaf spot of phlox. Plant Pathogy Circ. No. 268. Florida Dept. Agric. & Consumer Serv., Gainesville, FL. 2 pp.