

Small Scale Iris Production

Ross Brandon Eagles

Major Project/ Report submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Online Master of Agricultural and Life Sciences

In

Plant Science and Pest Management

Dr. Laurie J. Fox, Research Associate, School of Plant & Environmental Science,
Virginia Tech

Dr. Jeffrey Derr,

Dr. Holly Scoggins

Date of Submission – 11/24/2020

Keywords: Small Scale, Sustainable, Irises, Ornamentals, Perennials

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ABSTRACT

Many *ornamental crops* are produced by breeders, hobbyists, and garden enthusiasts through small scale operations. Making a thorough assessment of a site's potential will determine if it is suitable for such production. Each operation will have unique materials and equipment requirements. The challenge is making appropriate choices which allow for profitable production and future growth of the operation. Organizing and using production space efficiently is important to maximize crop production and profits. Using raised beds and row are two ways to do this on a small scale. Supporting healthy soil or growing media is also important and should supply the necessary nutrients for sustainable plant growth. Soil or growing media should be properly irrigated to provide consistent moisture for optimum crop production (Straw 2015). In addition to this taking the time to learn about the different types of plant stock and find quality sources for them is important. While production costs will differ based on an operation's supply sources there are many methods for arriving at a final price for a such products which involve some involve aspects of market research and psychology (Kohls and Uhl 2015, Uva 2009). Care for ornamental crops also involves integrated pest management (IPM), an assessment-based environmentally friendly cost-effective long-term way to manage pests in an operation as many pests can be managed effectively through good sanitation practices. In the end creating a good business plan will help to organize information, develop a budget, and think through what is needed to operate sustainably.

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Ross B. Eagles, Graduate Student, OMALS, Virginia Tech; Laurie J. Fox, Research Associate, School of Plant & Environmental Science, Virginia Tech; Jeffrey Derr, Extension Weed Scientist, Hampton Roads Agricultural Research and Extension Center, Virginia Tech; Holly Scoggins, Vice President, Educational Programs, American Hort

Many *ornamental crops* are produced by breeders, hobbyists, and garden enthusiasts through small scale operations. This publication covers key components of small scale in ground production including site evaluation, infrastructure, setup, production, pest management, and marketing. This publication is based on production methods used on a 1/8 acre bearded (*Iris germanica*) and beardless (*Iris hexagona* and *Iris siberica*) iris operation. Both types of irises are distinguishable from each other by the presence or absence, respectfully, of a fuzzy appendage referred to as a beard on the *falls* of the bloom which are further distinguishable from their vertically held counterparts referred to as *standards*. The information is targeted toward operations of about one to two acres in size.

Site Assessment

A thorough assessment should be conducted to determine if the site is suitable for production. Making a checklist from the questions below can be useful for gathering information to help make informed decisions.

Area

- Do zoning ordinances allow for a commercial business?
- Is the land open/clear enough for any necessary buildings or structures?

Sun/Shade

- Is there sufficient space for production areas in full sun, part sun or full shade for the kinds of plants you want to grow?

Topography

- What is the topography of the site? Is there a topographic map available?
- Are there slopes that would impact production areas, stormwater runoff (erosion), buildings, and foot or vehicular traffic?
- Can the topography be used to collect runoff as a source for irrigation water?

Soil condition

- Has there been a recent basic soil test? This would determine soil pH and *nutrient* levels which impact in ground production.
- Is the soil compacted? This could cause drainage problems and erosion and could require aeration and/or amending to correct the problem.
- Is the soil consistent across the property? Soil conditions can vary greatly across a property depending on the history of the property?

Wildlife

- What are the potential wildlife conflicts? Deer, geese, racoons, and voles can cause significant damage to production areas and crops.
- What would managing unwanted wildlife entail?

Water

- What are the crops irrigation needs?
- What will be the water source for irrigation?
- If using city water, that cost should be factored into the production costs.
- If using well water, it should be tested for quality and irrigation suitability.
Agricultural labs that test soil, often test water too. Well water can have high salts or iron that can discolor, stunt or even kill plants.
- Is there an existing pond on the site, or an opportunity to create a pond that could be used for stormwater collection and for irrigation? Are there any safety regulations about signage or fencing around the pond?

Materials and Equipment Considerations

Each operation will have unique materials and equipment requirements. The challenge is making appropriate choices which allow for profitable production and future growth of the operation. Acquisitions need to be carefully considered at all times to control expenses. Small scale operations have tight budgets. While some debt should be expected in the beginning when establishing an operation, eliminating any debt, and turning a profit as quickly as possible is the goal.

Considerations include:

- What does the operation need to start and function effectively at a minimal level?
 - Raised bed materials
 - *Growing media or soil amendments*
 - Irrigation infrastructure (overhead, mist, drip), timers, rain sensors

- Starter *Plant stock*
- Wildlife protection
- What activities will require specific equipment?
 - What specific equipment?
 - Are there alternatives which will work – build your own, borrow, lease, buy used, cost share with another producer?
 - Will the amount of use justify the cost of the specialized equipment?
 - Will the specialized equipment increase operational efficiency?
- Can the operation currently afford this material or equipment expense?
- Will this item address current needs, increase efficiency, pay for itself quickly?

Possible Materials and Equipment for startup:

- Hand tools – shovels, rakes, etc.
- *Cultivator/tiller*
- Weeding implements
- Growing media vs. existing soil
- Soil amendments
- Fertilizer and/or lime
- Framing materials for raised beds
- Irrigation system
- Wheelbarrow/cart
- Specific tools/equipment
- A website or marketing outlet

- Office – space, supplies, business software (accounting, inventory, sales), order fulfillment setup

Once the site assessment has been accomplished and materials and equipment information gathered, then the design, layout, and implementation can begin.

Planting Area

Organizing and using production space efficiently is important to maximize crop production and profits. Production space can be organized as either raised beds, rows, or a combination of the two. Any layout should be based on the site topography, crop requirements for optimum growth and access considerations. Using basic equipment like stakes, survey string, flagging tape or paint, a tape measure or measuring wheel, hammer and calculator, the production area can be laid out very easily and efficiently (Niemiera 2018, Schrock 1994). Figure 1 shows a temporary layout that can be used to test bed access and traffic flow patterns for people and equipment before the permanent installation.

Raised Beds

Raised beds create infrastructure above ground when the natural soil cannot be used due to compaction, poor nutrients, poor drainage, debris or roots, etc. (Schrock 1994).



Figure 1. A) gather needed equipment and supplies. B) Measure and stake production area and access pathways. C and D) Outline areas with string, tape or paint and check pedestrian, cart, or vehicle access and traffic flow patterns. Make any necessary adjustments before installing bed frames.

Sidewall height is usually standard treated board widths of 6 or 8 inches but can be whatever is practical or readily available. Landscape timbers, brick, pavers, or retaining wall stone are all possible materials which may be used. The frame height will impact the volume of growing media needed to fill the bed. Beds sited on slopes might only need the downhill sidewall to contain growing media. Seating the frame level and securely on the ground is important to prevent loss of growing media from under the frame edges (Schrock 1994).

One to three sided raised beds can work fine on slopes to create a terraced appearance while four sided beds are used on flatter terrain. The side walls of beds on slopes the can be tapered to fit the slope angle rather than excavating the hillside (fig. 2). Bed construction can be expensive. It should be based on the minimum number and size of the beds required to keep expenses down; expanding only based on operational demands. Using materials already on site or repurposed/recycled materials can make these costs manageable.



Figure 2. A) A three-sided 6'x 4' raised bed made from 8" untreated boards with sideboards (yellow outline) tapered to fit the topography. B) Two bed sections framed on the downhill side only using stacked landscape timbers (lower section) and a single 8" x 10' treated board (upper section). The timbers are secured with rebar (red) driven through 5/8" holes while the board is pinned in place between the rebar (red) and backfilled growing media.

Rows

Planting rows can be used alone or in combination with raised beds. Irises and many other perennials can be grown quite well this way (fig. 3). The same layout process as for raised beds

can be applied. Rows should run perpendicular to or across slopes not parallel to the slope so they do not create channels for runoff and erosion (Weil and Brady 2017).



Figure 3. Small Scale Iris production in rows with drip irrigation. (Photo courtesy of Superstition Iris Gardens, Catheys Valley, CA.)

Access

When designing a production space layout include access space in accordance with traffic flow requirements (fig. 4). It is important to consider who and what will be moving around the site along with where and to what they need access. Will it only be employees or will customers and tours need to be accommodated? Will there need to be separation of foot and vehicular traffic for safety/operational concerns? What type of equipment will be used – wheelbarrows, pull carts, golf carts, ATVs or cars and trucks? Pathway width, flow direction, surface material, edging and maintenance should all be considered. Pathways should be maintained as stable and passable regardless of type of traffic. Equipment selection and automated implements can reduce access space needs allowing more area to be used for production, thus increasing the

plants per unit area (Schreiner's 2020). Figure 4 is an example of an access pathway layout for an operation with both raised beds and rows and different types of traffic.

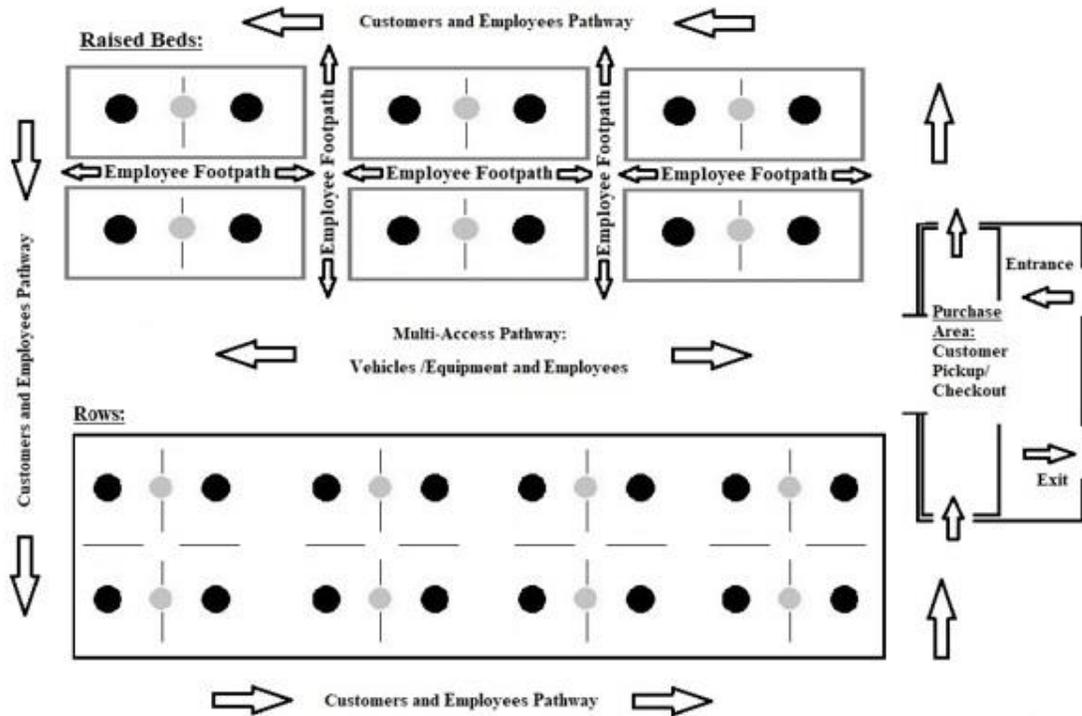


Figure 4. (Not to Scale): Example of an access pathway layout for an operation with rows and raised beds with traffic type and flow considerations.

Growing Media & Nutrients

Soil or growing media (in raised beds) testing should be done every 1 to 4 years or as needed based on considerations such as: media composition, plant growth issues related to nutrient deficiencies, adding amendments, renovating old beds, or installing new beds (Freeborn and Relf, 2017). Testing can be done independently in response to any of these considerations or as part of an annual nutrient management plan to determine if sufficient nutrients are available or if any corrections need to be made (PWSWCD 2020, Freeborn and Relf 2017). Fostering healthy

soil ecology by adding organic matter like plant or manure-based compost to your soil or growing media will reduce expenditures on chemical fertilizers while establishing a proper nutrient balance over time (Weil and Brady 2017). Soil with regular additions of organic matter will develop structure and a healthy microbial biome which supports healthy plant growth. (Weil and Brady 2017, Freeborn and Relf 2017). Figure 5 shows growing media in a raised bed which was initially composed of a plant-based compost mixed with existing heavy clay soil. The bed received annual top dressings of organic matter for six years. Note the healthy plant growth and few weeds present.



Figure 5. Structural development and a healthy biome in the growing media of a raised bed is a sign of ecological sustainability.

Healthy soil or growing media should supply the necessary nutrients for plant growth. The soil pH scale goes from 1 to 14, with seven being neutral. Below seven is acidic and above is basic or alkaline. The optimal range for growing healthy plants is 5.5 to 7.5 (Freeborn and Relf, 2017); where all essential nutrients are available. Some crops have specific growing conditions. Know your crop's preferred conditions and manage production spaces accordingly. For example, irises prefer neutral to slightly acid growing conditions, around pH 6.1-7.2 (AIS 2011). *Bearded Irises* prefer low nitrogen (N) levels with higher amounts of phosphorus (P) and potassium (K), while *beardless irises* do well with more even amounts of N, P and K. If testing shows that nutrients need to be added for a crop, then match the fertilizer to the crop. For example, bearded iris might need formulations such as 6-10-10 or 5-10-10 (N-P-K); while beardless irises might need formulations such as 8-8-8, 10-10-10 or 14-14-14 (Schreiner's 2020, AIS 2011). Fertilizers are applied twice annually according to label rates on the packaging roughly 4- 6 weeks prior bloom and any time after bloom all the way up to early fall regardless of the kind of irises being grown. Timing at the prescribed rate for your total growing area is the critical factor in the application and all applications should be stopped 2-3 weeks prior to the first hard frost (AIS 2011). Choose the correct fertilizer and application method or the crop. Fertilizers can be mixed with water and applied manually as a liquid drench or siphoned through the irrigation system. Granular applications can be broadcast over a bed, applied to an individual planting hole or row, or incorporated into a bed area. Granules can be quick release when dissolved by irrigation, rain, or soil moisture, or they can be controlled (slow) release over a 3-4 month growing season.

Irrigation

Soil or growing media should be properly irrigated to provide consistent moisture for optimum crop production (Straw 2015). It is generally recommended that a rate of 1 inch of water per week be applied in the absence of natural rainfall to wet soil to a depth of 5-6 inches (Straw 2015, SNA 2020). Each crop's watering requirements are different and are influenced by the soil or growing media. For example, bearded irises, once established, do not require much additional amounts of water beyond what is provided by natural precipitation; while beardless irises prefer more frequent and consistent moisture levels (Shreiner's 2020). *Mulching* production spaces can conserve water, reducing irrigation costs.

Consider the irrigation source carefully. Irrigating from a public water source incurs usage charges, which increases operational expenses (PWCSA 2020). Use of well water will require specific tests to determine if the water quality is appropriate for irrigation purposes. Nutrient and mineral levels in well water can be high enough to be toxic to plants and can affect fertilizer use. The supply pressure and the number of wells needed to accommodate crop production should be determined early in the planning process (SNA 2020). Installing a well can also be expensive and significantly impact the budget. Irrigation water from a pond or collection tank/cistern should also be tested to determine quality. Filters will definitely be necessary on systems using well, tank or pond water to prevent clogging of the irrigation heads or *emitters*.

Commercial irrigation companies have websites and consultants that can help with designing a system appropriate for a specific crop. It is better to work through a design on paper first before installing a system (Rainbird 2020, Orbit 2020, Dripdepot 2020, Dripworks 2020, Mister Landscaper 2020). Systems can distribute water differently based on what is needed. Common types of irrigation systems are micro-drip, drip and overhead mist or sprinkler. Drip systems apply water at the soil surface which reduces evaporation and the overall amount of water applied (SNA 2020). Irrigation should be scheduled for early in the day, which allows time for the soil/growing media and plant foliage to dry throughout the day. This controls diseases which can thrive under moist conditions. Figure 6 shows components of a micro-spray emitter system which can be connected to a rainwater harvesting tank with a controller.



Figure 6. A) Emitters in beds directing water at the soil surface not onto plant foliage. B) Supply lines articulated to conform to irrigation needs. C) Supply lines can be buried underground or under mulch. D) Feeder lines and emitters which can withstand annual applications of organic matter. E and F) Quick connect ends for partitioning of beds with different plants and watering requirements. G) Rainwater storage tanks for supplemental water to reduce demand/reliance on wells or public water sources. H) A tuna can rain gauge to determine uniformity of distribution. I) A programable timer to schedule irrigation cycles. A rain sensor should be included in the

irrigation design, so the system will not run when there is sufficient natural rainfall.

Overwatering can cause poor crop growth and encourages diseases.

Plant Stock

Take the time to learn about the different types of plant stock and find quality sources for them.

Iris are generally sold as single *bare root divisions* from primary sources but can be found in pots from secondary sources as well; and even grown from seeds when dealing with species or wild-type *varieties*.

Stock Selection

Hybridizers generally have their own businesses or sell their iris direct through larger grower/hybridizer operations which may offer stock at wholesale prices if you need large quantities. Most horticultural and plant societies also have source lists. All three of these can be primary sources for high quality, pest free, and true to name stock. Secondary sources should only be used if you can see the plants in bloom to confirm stock identity. The burden is on the purchaser to know what you are buying since secondary sources may not know much about the plants. Stock plants may also be obtained at auctions but at high prices which can be prohibitive.

There is a much smaller market for species irises, varieties and those irises beyond 30 years, referred to as *historic irises*, which are still of some commercial value (Joe Pye Weed's 2020, AIS 2020, HIPS^b 2020, BHIG 2020). These irises are generally sought only by hobbyists-collectors and conservationists for use as landscape plants. Species iris were useful in early hybridizing efforts, during the 1800's, to establish commercially viable modern hybrids which

expressed better traits such as more vigorous growth, disease resistance and larger more colorful and abundant blooms. For operations interested in these irises the primary sources are specialty growers listed on iris society source lists (AIS 2020, HIPS^a 2020). Small quantities may be found through secondary sources sold as potted perennials at market prices. Many irises are grown from seed which can cost little to acquire (SIGNA 2020).

Operations involved in both resale and hybridizing of plants should select stock which will serve both purposes. Quality plant stocks exhibit both vigorous growth habits and interesting genetic traits which support good sales volumes and allow for their use in hybridizing new higher priced introductions. Inferior stocks are those which do not perform well in these same characteristics. They should be removed from inventory to be composted or put into the trash and not utilized for sales or hybridizing. Diseased stock should be discarded in the trash and not utilized under any circumstances. Stock which does not suit hybridizing goals or has become commercially unviable but still grows well may be sold at a discount.

- Primary Sources:
 - growers and hybridizers with established reputations
 - horticultural society plant sales
 - horticultural society source lists
- Secondary Sources:
 - Plant auctions
 - Garden centers
 - Friend's home gardens
 - Family hand-me-downs

- Roadside plants
- Unknown *Cultivars* with **NO ID**entity (*N.O.I.D.* status) (HIPS^b 2020)
- Stock acquired through extended supply chains of two or more sources

Pricing

There are many methods for arriving at a final price for a product; some involve aspects of market research and psychology (Kohls and Uhl 2015, Uva 2009). At the very least the plant price should cover production costs with a markup for profit. Take time to research current market pricing and trends. Sales could include the resale of currently available cultivars and varieties, sales of newly hybridized introductions or a combination of both. Table 1 shows how 2,000 square feet of bed space within a 1/8-acre area may be allocated as an iris production operation to support both resale and hybridizing functions along with expansion space for future growth of the operation. This table does not account for access space. Selling larger quantities of currently available cultivars at standard market prices is a different business model than selling smaller quantities of new cultivars at higher premium prices. The novelty of new introductions is what drives the high prices initially. Garden performance influences prices later as cultivars age and people share their gardening experiences. New introductions depreciate over an average 30-year commercial lifespan down to the standard commodity price ranges as shown in Table 2. Market demand, cost of production and commercial age of each cultivar ultimately determine when a plant is no longer commercially viable (worth producing). Each operation must make its own determination regarding this cutoff point.

Table 1. Breakdown of 2,000 square feet of bed space by function.

Plant Stock	Cultivar #'s (a)	Bed Space ft ² (b)	Ft ² / Cultivar (b / a)	ft ² %
Resale Plant Stock: (1 to 4 starter plants of each cultivar)	200	800	4	40
Hybridizing:(seedlings)	150	600	4	30
Expansion Space:	TBD*	600	TBD*	30
Total Area		2,000	NA [^]	100

* TBD = to be determined. ^ NA = Not applicable.

Table 2. Market values of plant stock of three kinds of irises plus species/varieties and their introductions. Price ranges for regular stock are the lowest market values at 30 years post introduction. Prices for introductions are the highest market values, generally set for the first year of sales. Species/Varieties market values reflect their rarity against market demand.

Iris Plant Stock ²	Average Market \$ / Plant ¹	Commercial Lifetime \$ Range (1-30 years)
Depreciated Regular Stock:		
• Bearded	\$5-7	\$75-5
• Siberian	\$6-8	\$35-6
• Louisiana	\$8-10	\$50-8
• Species/Varieties	\$10-25	\$25-10
First Year Introductions:		
• Siberian	\$35	
• Bearded	\$75	
• Louisiana	\$50	
• Species/Varieties	\$25	

¹ Prices referenced at: Schreiner's 2020, Winterberry Gardens 2011, Joe Pye Weed's 2020, Hillcrest Irises 2019, Decadent Daylilies 2020). ² Except for the Species/Varieties plant stock groups listed refer to hybrid cultivars.

Cost of Production (COP)

Production costs will differ based on an operation's supply sources but they include all direct costs incurred in production of the final product minus shipping; which is charged by the operation and paid by the consumer. Figure 7 shows an example of how-to setup a cost of production calculator with some basic costs using a spreadsheet in a program such as Excel (Microsoft 2020). These numbers are necessary to inform marketing and sales decisions. In this example setup below the #2 colored cell functions are shown in the white boxes along the left and right sides with colored arrows indicating which cells they are entered into to total each row. The data for your COP calculator will be your actual costs, cost estimates and/or other related numbers, which are entered into the #1 and #4 colored cells as indicated by the key. Each #3 colored cell is linked to a #2 colored cell by its own simple "equals" function typed in as shown for the #3 colored cell B14 in the example.

For the purposes of this example the numbered colors, #1 to #4, in the cell key help with understanding the setup and what is to be entered where, as data or as a function, to make the calculator work properly but they are not essential to the setup. Adding your own color scheme is up to you. Excel's has a function menu denoted by "**fx**" in the menu bar at the top of the application window which is an easy way for you to select what you want to calculate, enter the number ranges and have the program set up functions for you in specific cells. Other spreadsheet programs may have a similar menu and it is not hard to learn to enter your own functions on your own following standard ones as examples. You can label and order your own spreadsheet to suite your needs. The end goal of figure 7 is to show how cost figure into determining a resale value and how a markup figures into the calculations to turn a profit. It is not all inclusive. Your setup will reflect your operations unique costs but you can experiment

with this kind of setup using real numbers or estimates to help set sales price goals and understand the effects of costs and markup on profit base on the size of your operation.

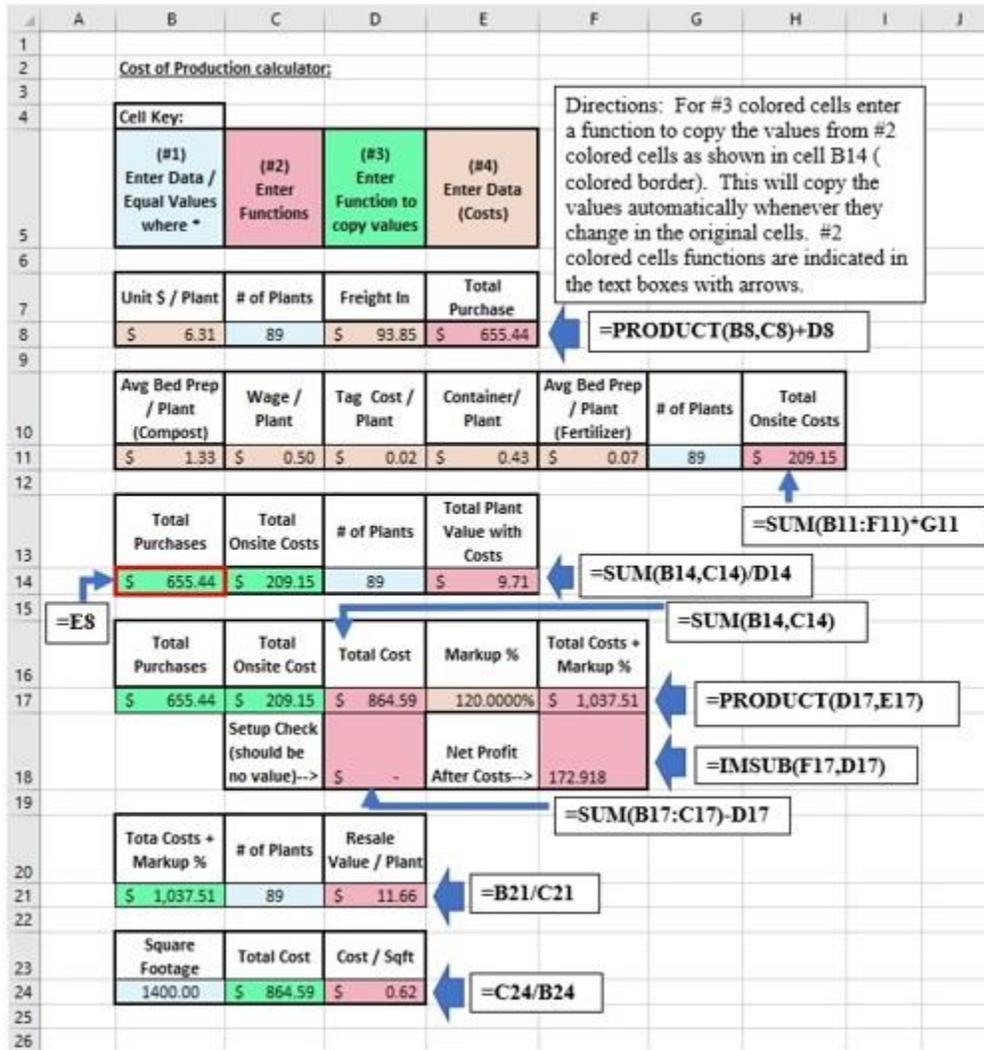


Figure 7. Cost of Production calculator setup.

Plant Spacing

Appropriate plant spacing will increase stock and optimize production by getting the greatest number of plants per square foot of production space. Figure 8 shows two different spacing

diagrams for iris production. Diagram “A” works if the plant stock is large and quantity is nearly equal to production space square footage at one plant/ft². Diagram “B” works if there are more plants/ft² and the plant stock is smaller. Smaller plant stock can be planted more densely per each square foot and staggered to establish more plants within the same production space.

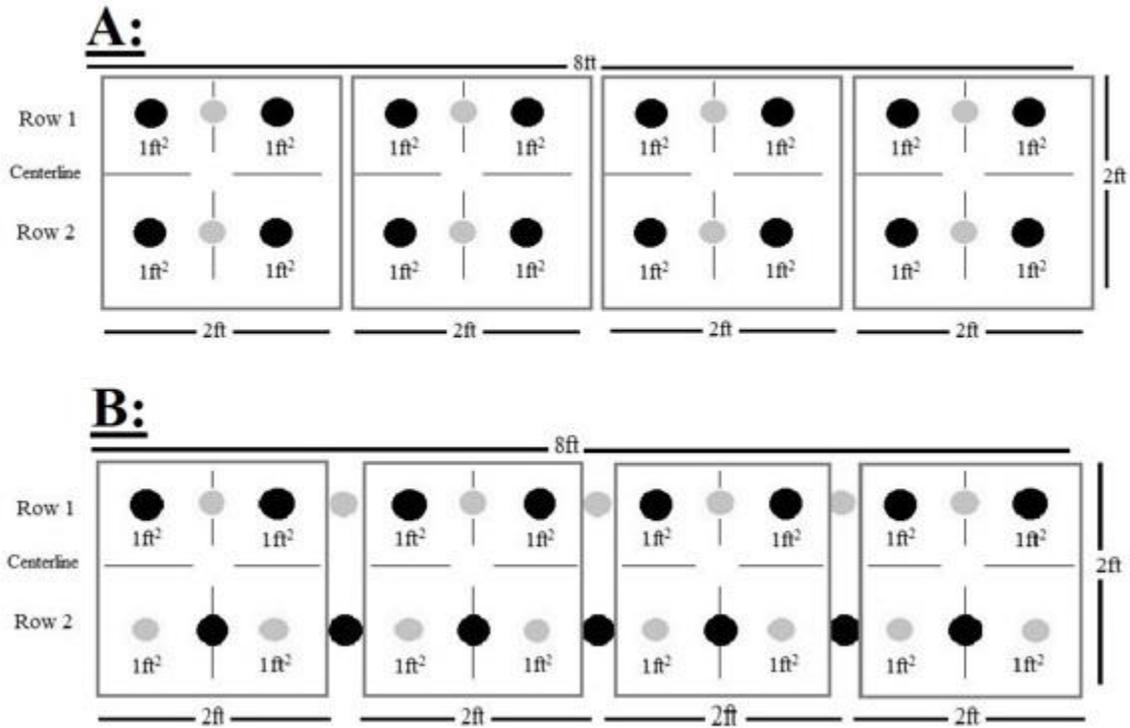


Figure 8. A) Parallel rows with plants spaced evenly within each square foot. B) Parallel rows with a staggered or offset plant spacing. Black dots are the primary plant locations within A and B. Grey dots indicate alternative planting locations within A and B which can be chosen depending on plant sizes, quantities to be planted and grower preferences for spacing.

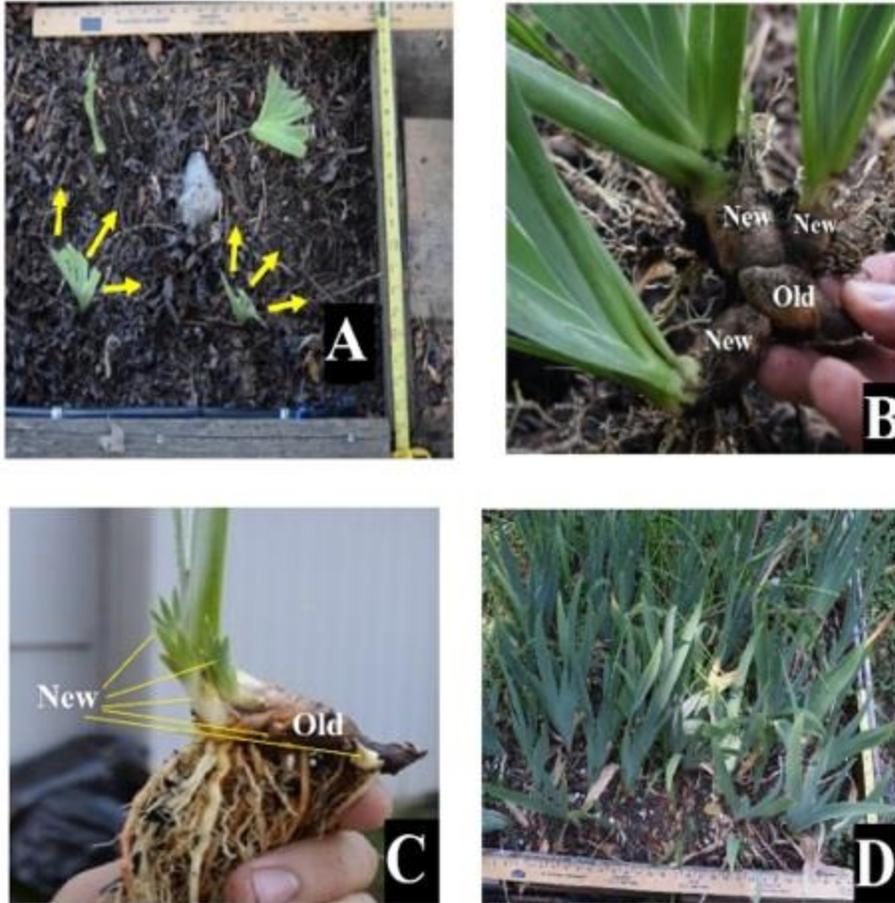


Figure 9. A) The circular growth pattern of new plants away from the parent (yellow arrows). B and C) New growth off the parent plant (Old) with multiple vegetative fan divisions (New). D) 3 to 4 years of growth from properly spaced plants.

The growth patterns of irises are predictable, which allows for determining optimum spacing (fig. 9 A and D) and quantities a given area of bed space can support based on their *rate of increase*. Most irises grow by annual *vegetative increase*, which may be called *fans*, that form along the front and sides (fig. 9 B and C) outward in a semicircular pattern from the parent plant. Siberian irises are an exception, growing outward generally in a circular pattern away from the

original parent plant. *Fan divisions* which can be separated as *clumps*, should occur as needed or on a schedule to maintain optimum growth within a given production space to avoid overcrowding (Table 3). Division frequency depends on the type of iris and how vigorously they grow (Schreiner’s 2020). For Siberian irises, any older portion of the small *rhizomes* can be removed and discarded during transplanting; especially if already dead. With Louisiana and bearded irises, the old rhizome may still have new divisions attached or be healthy enough to form new divisions, even without any green shoots; increasing stock for an extra year. These old rhizomes will eventually die and rot away adding a small amount of nutrients back into the growing media. It is acceptable to discard or replant an older rhizome depending on its condition at the time of transplant. Aside from this one exception only healthy fan divisions with green shoots and good roots should be transplanted.

Table3. Common fan division size and transplant intervals for three kinds of irises. Transplant intervals should also be adjusted as needed to maintain vigorous growth and bloom of plant stock.

Plant Stock:	Fan Divisions to Transplant as a clump:	Division Interval:
• Bearded	1-2	3-4 years
• Louisiana	1-2	3-4 years
• Siberian	3-4 or more	4+ years

Planting Depth

Bearded and beardless irises prefer different planting depths which aid directly in successfully production of them. Rhizomes of bearded irises should be planted in the upper 1-2 inches of the growing media so the tops of the rhizomes are just barely exposed at the surface along with the *crown* (SIG 2020). Both Siberian and Louisiana irises prefer their rhizomes planted about one

inch below the surface of the growing media with any equally deep layer of mulch applied afterward. Replenishing the mulch will benefit beardless irises as it degrades into the growing media (SSI 2020, ICG 2020).

Pest Management

Integrated pest management (IPM) is an assessment-based environmentally friendly cost-effective long-term way to manage pests in an operation. IPM uses a combination of cultural, biological, mechanical, and chemical solutions to pest issues (Blevins, Frank and Beegle 2020, Latimer 2016).

Integrated Pest Management

Many pests can be managed through good bed sanitation. Cleaning tools between uses to avoid spreading diseases between beds and controlling weeds, which compete for light, nutrients and harbor a potential insect and disease pests are two examples of IPM. Another example is to closely monitor irrigation. A drip system keeps foliage dryer than an overhead system. A rain sensor will turn off the irrigation system when there is sufficient rainfall. Dryer plant foliage and soil prevents diseases (Shear 2002). Other IPM strategies include understanding a pests' lifecycle to know when to intervene with treatments, minimizing *pesticide* use, using the lowest toxicity products, mulching to moderate soil moisture and control weeds, purchasing pest free high quality plant stock, immediately culling out and disposing of sick plants, releasing and or supporting beneficial/predatory insect populations, and frequent scouting to catch and deal with pest problems early (Blevins, Frank and Beegle 2020, Herbert 2020).

IPM will not necessarily eliminate all pests, but it should keep pests in check at low tolerable levels (Blevins, Frank and Beegle 2020). More specific information on IPM can be found in the Virginia Tech Home Grounds and Animals or Horticulture and Forest Crop Pest Management Guides (Close and Latimer 2020, Day and Hong 2020).

The major steps of an IPM program are (Blevins, Frank and Beegle 2020):

- Scout frequently
- Identify the pest
- Monitor the pest population and assess the damage
- Determine a threshold for when management action is needed (e.g., the point at which the economic loss is intolerable)
- Examine management/treatment options
- Use the one or combination that best fits the situation
- Evaluate how well it worked
- Try to prevent the pest problem from occurring again

Insects

Become familiar with the common pests of the crop. The main insect pests in iris are aphids (fig. 10) and the iris borer (fig. 11). Aphids can be washed or brushed off the plants or managed with predatory beneficial insects or insecticides. Damage from aphids is generally cosmetic, but they can carry diseases (Day 2020). The iris borer is a native moth larva which is found mainly in the Eastern U.S. states (Shear 2002, Dellinger and Day 2015). The borers attack both native irises and non-native bearded iris and hybrids but seem to do more damage to the non-natives. The

borer life cycle (fig. 11) is easily interrupted with annual debris clean up and immediate removal of damaged plants (Shear 2002, Dellinger and Day 2015).



Figure 10. Adult and nymph aphids (Hahn and Wold-Burkness 2019).

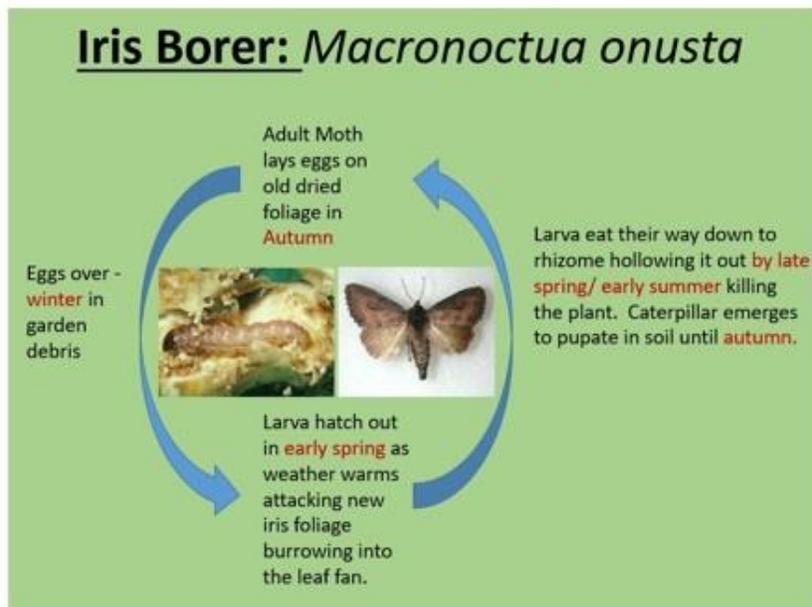


Figure11. Iris Borer Lifecycle (Hahn and Fetzer 2018)

Diseases

Iris diseases are caused mainly by fungi or bacteria (Table 4). Viruses and conditions with unknown origins, such as scorch, make up a small percentage of iris diseases. With viruses, affected plants are removed. With scorch, the condition is generally not fatal or contagious, and plants eventually recover with some basic treatments (Shear 2002, Warburton and Hamblen 1995).

Table 4. Common iris diseases and problems.

Pathogen	Symptoms	Conducive Conditions	Treatment
Bacterial Leaf Blight (bacterial leaf spot) (<i>Xanthomonas tardicrescens</i>)	Similar to fungal leaf spots. Spots can run together forming non-distinct smears. Heavy exudate as the disease progresses. Presents as tiny watery pinholes and thin short track marks no wider than a ballpoint pen tip at leaf margins.	Wet weather and mild temperatures.	Good bed and tool sanitation, 6% bleach solution to dip tools between uses. Disposable gloves when working in infected areas, Cleanups for fungal leaf spot can remove inoculum before it ever causes symptoms.
Fungal Leaf Spot (<i>Didymellina macrospora</i>) (Other Pathogens: <i>Alternaria iridicola</i> , <i>Ascochyta iridis</i> , <i>Asteroma venulosus</i> , <i>Cylindrosporium iridis</i> (most common), <i>Mycosphaerella macrospore</i> , etc.	Brown circles on leaf tips with dark centers and spores. May briefly have a watery appearance as they mature	Wet, humid and windy conditions as well as careless hygiene practices. Working with infected plants under wet, humid windy conditions	Regular removal of old leaves and infected leaves. Keep leaves dry. Increase space between plants for air circulation. Fungicides
Bacterial Soft Rot (<i>Erwinia carotovora</i>)	Rotting rhizomes smell like rotten potatoes. Leaf fans wilt, die and can be pulled free from the rhizome at the	Wet weather and mild temperatures. Becomes inactive during the winter months.	Remove affected tissue. Expose cleaned rhizomes to sun, allow to dry, replant. Avoid wounding rhizomes. Control insects that

	<i>crown</i> in advanced stages have yellowish mushy rhizomes.		feed on rhizomes. Disinfectant tools between each use. Dispose of diseased material in trash. No known chemical treatment.
Fungal Soft Rot (Crown Rot) <i>Sclerotium rolfsii</i> - Mustard Seed Fungus	Yellowing leaf tips with basal rot and leaf fan collapse. Rhizome rot by secondary infections of bacterial soft rot. Gray or tan cotton-like masses on adjacent soil, rhizomes and leaf bases.	Warm weather with any moist soil.	Bed sanitation and cleanups. Exposure of plants to sun once cleaned of infected tissue. For advanced infections dig plant completely, remove infected tissue and treat with sun replanting in new soil and location.
Fungal Soft Rot (Botrytis Rot) (<i>Sclerotinia (Botrytis) convoluta</i> - Botrytis Rhizome Rot)	Black mold over the outer surface of infected rhizomes and roots. Plants do not grow. Rhizomes are brown instead of white inside.	Cool wet weather. In fall rhizomes suffer from dry rot. New growth does not appear the following spring.	None, rhizomes must be cleaned of infected material, dried and replanted in clean soil to stop the disease if present.
Iris Rust (<i>Puccinia iridis</i>) (very rare)	Small rusty-brown lesions over entire leaf surface. Dusty spores as with all rusts. Stunted growth.	High humidity and moderate temperatures. Excess moisture. Fogs, dews, rain or irrigation systems encourage spread and growth.	Sanitation and careful cultivar selection to grow resistant plants. Careful removal of infected tissue or whole plants is effective. Irrigate beds when plants can dry out prior to nightfall.
Scorch (unknown pathogen)	Infected rhizomes remain firm while roots rot and die. Foliage exhibits a dwarfing effect with lack of growth and yellowing of central leaves. Leaves cannot be	Unknown	Unknown but some plants have been successfully treated by digging infected rhizomes, drying in the sun for a few days to weeks then replanting.

	pulled free of crown.		
Pineappling (Unknown Pathogen if any)	Enlarged rhizomes, Dwarfed foliage folded or pleated. Flower stems stunted, clubbed and malformed. Underdeveloped roots.	Unknown, occurs sporadically but does not appear transmissible between plants.	Unknown, affected plants either die or resolve the condition on their own.
Bearded iris mosaic virus, Iris mild mosaic virus and Iris severe mosaic virus.	Reduced vigor and quality, stunting, light green stripes or streaks, teardrop shaped spots on leaves, mottling of flower stalk	Spread by aphids or other sucking insects	Control aphids, cull out and dispose of plants in the trash, quarantine plants to see if virus appears next season

Information credit: Hansen 2016, Moorman 2016, Shear 2002, Warburton and Hamblen 1995.

Business Management

Business Management includes many different aspects of an operation. When starting and/or running a small-scale operation, the owner may perform most of the tasks. While each business is unique, some considerations are common to them all.

Business Plan & Budget

Creating a business plan is a good way to organize information, develop a budget, and think through what is needed, when, and how. Resources for creating business plans are available from small business associations and online. A well-done business plan and budget has many uses including: (White 2007):

- identifying all of the inputs needed to produce the business
- identifying the top 5 expenses for cost control management

- determining potential changes in the business
- estimating the minimum operating loan that might be requested from a lender
- determining how much revenue can be generated from the business
- determining a breakeven analysis for price and yield

Software

Select software that can best accommodate the business needs. Commonly available software packages can save time and money, are usually user friendly and have technical support available. Customized software and outsourcing tasks can be considered as the budget allows.

- communications (e-mail, website, social media, publicity & marketing)
- office activities (word processing, spread sheets, photo/design/presentation, marketing materials)
- data management (plant & hybridizing records, cultural information, checklists)
- inventory management (availability, sales, stock, pricing, supplies, reorders, shipping/tracking)
- record keeping (billing/order fulfillment, sales, taxes, payroll, purchases, production costs, revenues, operating expenses/variable costs) financial analysis/evaluation (quarterly & annual reports, cost analysis, long term goals & benchmarks, progress reports, trends, problem identification, revenues vs, operating expenses, fixed costs, assets)

Marketing

Marketing covers a broad spectrum of aspects in iris production. Everything from how the operation presents itself physically to its advertising campaigns will involve some aspect of communication with prospective customers. Choices about marketing should be reasoned and informed when dealing with limited budgets in order to be effective. Some things may not work even when done well, but it is important to understand what does not work and why in order to find what suits the operation.

The following questions are important in any marketing approach:

- What exactly is being marketed?
- Who is the target market audience?
- How do they receive their information?
- What are the best marketing outlets/platforms/avenues for the product?
- What marketing materials need to be developed (logo, business cards, content for website and social media)?
- How will customers be engaged, responded to?
- Are there geographic marketing boundaries which need to be addressed with permits and inspections (local, regional, national, international) such as for United States Department of Agriculture: Animal and Plant Health Inspection Services (USDA: APHIS 2020, VDACS 2020)
- Are there domestic regulations that impact marketing (inspections/certificates)? Each state has a nursery permit requirement for interstate commerce such as the Virginia Department of Agriculture and Consumer Services (VDACS 2020).

Summary

Starting a small-scale iris production operation can be challenging and exciting but with sound decisions it can be done well in a sustainable and practical manner. Compliance with the regulations and ordinances for your operation's location will still leave much room for the creativity and ingenuity which comes from addressing one's own specific challenges along the way in setting up and running a new operation to make it self-sufficient.

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Glossary

Bar Root - Harvested plants from which the soil or growing medium has been removed.

Bearded Irises - Any of numerous wild or cultivated irises with a growth of short hairs on each fall.

Beardless Irises - Any of numerous wild or cultivated irises having no growth of short hairs on each fall.

Clump – Specific to daylilies, this term refers to three or more fans of a cultivar grouped together. A more general usage, applied to irises, simply refers to any grouping of fans separated from the larger grouping during division of a larger grouping which can be effectively transplanted to grow new plants and increase the plant stock.

Cultivar/s - A plant variety that has been produced in cultivation by selective breeding but does not produce true-to-seed.

Cultivator - A mechanical implement for breaking up the soil and uprooting weeds.

A cultivator is primarily used to mix loose soil. It is unlikely to work if you are creating a new growing space due to its light-duty tines.

Crown - The total of an individual plant's aboveground parts, including stems, leaves, and reproductive structures. In irises it is generally referred to as the growing point of the plant at the soils surface from which the above ground parts develop from.

Division/s - The action of separating something into parts or the process of being separated.

In horticulture and gardening, is a method of asexual plant propagation, where the plant (usually an herbaceous perennial) is broken up into two or more parts. Both the root and crown of each part is kept intact. Also, a term for describing an individual unit of a clump, containing leaves, crown, and roots identical to the parent plant. Interchangeable with the terms “Fan” and “*Ramet*”.

Emitter/s - A device used to distribute water for irrigation that can discharge in droplets, small streams, or through mini-sprayers.

Falls - The three lower petals of the iris flower, correctly called sepals, that may either hang down, flare out, or curl under the bloom.

Fan - Descriptive term for the growth habit of certain perennial plants, such as *Iris* and *Hemerocallis*, which have no vertical stem because the leaves originate from the rhizome. May precede the term “Division” to provide a more descriptive compound term for an individual unit of a clump, containing leaves, crown, and roots identical to the parent plant. The term is interchangeable with the terms “Division” and “*Ramet*”.

Growing Media - Any substance through which plant roots grow and extract water and nutrients. It can act both as a reservoir and/or source for nutrients depending on its composition. Both mineral soils, which provide nutrients directly, and peatmoss-based planting media, which do not, are examples of growing media.

Historic Irises – Irises which have been actively sold in commerce for at least 30 years attain this designation. They can still be sellable in a more specialized market for such older irises.

Increase - A general shortening of the term “vegetative increase”.

Plant Stock – Refers to any plant or plant tissue, including rhizomes, shoots, leaf or stem cuttings, roots, crowns, or tubers used in plant production or propagation.

Ramet - Refers to individual plants in a clump, each portion of which is identical with the original parent plant. Interchangeable with the terms “Fan” and “Division”.

Rate of Increase - A measure of the vigor of a cultivar, specifically irises, referring to how many new iris plants are produced within a defined time period. Dividing the total number of plants of a given cultivar by the number of years over which it has been grown gives the annual rate of increase. Other rates might be a per clump rate of increase where you divide the same total number of plants by the number of clumps. For irises rates of increase greater than 3 are preferred in order to generate sufficient production quantities for commercial sales.

Rhizome/s - A continuously growing horizontal underground stem which puts out lateral shoots and adventitious roots at intervals. Also described as the underground portion of stem modified for energy storage by plants such as irises which supports roots and the vegetative portions of the plant.

Mulch - Any material which is left on the soil surface. Its purpose is to reduce evaporation and runoff, inhibit weed growth, and create an attractive appearance. Mulches also moderate soil temperature. Organic mulches may be incorporated into the soil as amendments after they have decomposed to the point that they no longer serve their purpose.

Nutrient - A substance that provides nourishment essential for plant growth and the maintenance of life. They differ from a soil amendment in that they do not improve its physical properties.

N.O.I.D. - A designation specific to irises as a shorthand version of “No Identification” abbreviated as **N.O.I.D.** to indicate any plant unidentifiable by registered name.

Ornamental Crops - Are plants that are grown for decorative purposes in gardens and landscape design projects, as houseplants, cut flowers and specimen display.

Pesticide/s - A substance used for destroying insects or other organisms harmful to cultivated plants or to animals.

Soil Amendments - Any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration, and structure. The goal is to provide a better environment for roots.

Standards - The three upright petals of the iris flower.

Tiller - A mechanical implement designed to break up hard, compact soil into loose, broken-up dirt that can then be used for planting. Generally used when establishing a new growing space.

Variety/Varieties - A group of plants within a species that has one or more distinguishing characteristics and usually produces true-to-seed.

Vegetative Increase - The new plant developing along the side of the parent plant annually at or just below the soil surface specifically used when referring to irises and their annual growth cycle. Many times, simply referred to as “increase” with the plural being “increases”.

Acknowledgements

Acknowledgements for support, feedback and inspiration for this publication goes to the following persons; Laurie J. Fox, Jeffrey Derr and Holly Scoggins as the chair/advisor and members of my committee respectfully. Rick Tasco and the late Roger Duncan of Superstition Gardens, Don Spoon of Winterberry Iris Gardens and my parents Douglas and Joyce Eagles.

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