

Winter-Rainfall Bulbs from Seed

Workshop presented to the

Central Arizona Cactus and Succulent Society

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by
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Objectives.....	2
What is a bulb?.....	2
The winter-rainfall climate.....	3
Winter-rainfall growth patterns.....	4
Habitats of winter-rainfall bulbous plants.....	5
Basic plant requirements.....	5
Sprouting winter-rainfall bulb seed.....	6
First dormancy and storage.....	8
The next fall.....	9
Transplanting.....	9
Produce your own seed.....	9
More information (Books, Organizations, Sources).....	9
Appendix I: Importing living plant material to the USA.....	11
Appendix II: Some winter-rainfall bulbs.....	13
Appendix III: What we plan to give you.....	16
Blank space for notes.....	19

Objectives

- Learn what is a "bulb" to a gardener and what is a **bulb** to a botanist
- Through hands-on experience, learn how to grow some amazingly beautiful winter-growing geophytes, from seed, in the lower Sonoran Desert
- Learn about "bulb" biology and taxonomy, and some of the big "bulb" families
- Learn about the Mediterranean climates throughout the world

What is a bulb?

The term "bulb" is used commonly for any mostly or fully underground lumpy thing from which can grow a plant. That is how I used it in the title. However, to a botanist, a **true bulb** is a compressed and modified entire plant that usually sits underground, pushing some leaves and its flowers out of the ground. The best-known true bulbs are onions and garlic, in the family **Alliaceae**. Think of an onion. The underground plant stem is compressed to form a flat **basal plate**, from which grow roots below and leaves or flower stalks above. Above the basal plate are layer after layer of compressed scales, which represent leaves modified into storage organs. From the center of the scales may grow green leaves or a flower stalk. If the basal plate dies, the bulb is dead. Other plants with true bulbs include the other members of the onion family, the family **Amaryllidaceae**, and the family **Liliaceae**. True bulbs can usually be propagated by taking slivers of the parent bulb including a portion of the basal plate.

Some other things we call "bulbs" are known to botanists as **corms**, which are modified underground stems in monocots. (Monocots are the large group of plants that only have one seed leaf, as opposed to dicots, which have two.) Corms are thick for food storage. They contain growth points (called colloquially "eyes") from which grow stems bearing leaves and flowers. Most corms disappear as the plant breaks dormancy and grows, the stored starch being used to form the new top growth. The plant then forms a new corm or corms to survive the next dry season. Then the plant flowers. Many members of the iris family, **Iridaceae**, use this strategy. Other cormous plants include aroids, family **Araceae**. Many corms can be cut into multiple pieces and, so long as each piece contains an eye, each piece should produce a plant. If you fail to water a just-sprouted cormous plant before it has formed the new corm it will die.

A **tuber** is a perennial underground stem with growth points. The tuber does not disappear while above-ground growth occurs, as does a corm. The potato is the best-known tuber. It is in the nightshade family with tobacco, tomatoes, petunias, eggplant, and **Datura**. Some people consider **Datura** to have an underground storage organ, but the other nightshades don't. Other tuberous plants include bananas (**Musa**); sweet potatoes, which are actually morning glories (**Ipomoea batatas**); **Dioscorea**; the queen's wreath vine, **Anredera cordifolia**; the Arizona queen of the night cactus, **Peniocereus greggii**; and dahlias, **Dahlia**, in the daisy family **Asteraceae**, which we can't grow here without a huge amount of luck. If you fail to water a just-sprouted tuber it will not die; the top growth may disappear, but the tuber will keep producing growth so long as it has enough water, contains enough food and has remaining eyes.

A **rhizome** is an underground stem which grows sideways rather than up. Above-ground sprouts form periodically from the rhizome but usually don't last more than a few years. The rhizome continues to

grow linearly and produce more above-ground sprouts. Old sections of rhizome may push new growths if the front section is removed. Well-known rhizomatous plants are many grasses including bamboo, bearded iris (*Iris germanica*), and various ginger.

Gardeners who want to seem more sophisticated use the term **geophyte** to refer to any plant growing from an underground storage organ.

The winter-rainfall climate

Less than 5% of the Earth's surface receives rain primarily or solely during the cool to cold winter months, with little or none in the summer. This is often called a **Mediterranean climate** because much of the land surrounding the Mediterranean sea experiences such a rainfall pattern.

Mediterranean-climate regions tend to be coastal, and usually have a cold offshore current. The cold water frequently brings fogs during the early parts of the spring into summer, and often in the fall as well. This moderates summer temperatures, which makes survival during the summer easier for dormant plants.

Many beautiful plants have adapted themselves to these cool, wet winters and long, hot, dry summers. Today we will concern ourselves with some of the bulbous plants from these climes. We can grow many of them quite well in containers with just a little extra attention during the summer. We are quite fortunate in this regard; Mediterranean-climate plants are difficult to manage in temperate climates with humid summers and freezing winters. By growing these plants we can have succulent plants in active growth and flower throughout the year. I know some people don't consider bulbous plants to be succulents, but I think any plant that can survive over 6 months without water at the roots qualifies as a succulent.

The closest region with this climate is the entire west coast of the USA, from Oregon south, and extending as far south as El Rosario in Baja California, Mexico. Other well-known regions with this climate include coastal Chile and Peru; the southeast and southwest coasts of Australia; the west coast of Africa, extending up into Angola; the Canary Islands; and the northwest portions of Djibouti and the Horn of Africa. Southwest Africa has never been covered by glaciers. This is why botanists think so many species survive there. The winter-rainfall bulbs from southern Africa are amazing gems. The winter-rainfall pattern is what distinguishes Mediterranean climates. Winter high and low temperatures are variable, though. Many such regions experience severe cold, much colder than we ever have. Such areas include some of the inland parts in the winter-rainfall regions of southern Africa. Some regions experience cool winters but with warmer nights than ours. Plants from these regions may not be able to tolerate our winter frosts. But, in general, most winter-rainfall plants luxuriate in a typical Central Arizona winter, with a little more water than we get as rain.

Fire is a natural feature of many Mediterranean climates, including coastal California. After the long, hot summer, dry and dormant vegetation is like tinder. Late summer lightning may trigger huge burns. The plant communities are adapted to this, with many shrubs resprouting from the roots and many bulbous plants flowering well only after a fire has been through. The California vegetation is called chaparral and the South African equivalent, fynbos. Some plants from these regions have seeds that will not sprout unless exposed to smoke-treated water. The thinking on this is that before fires the brush is so dense there would not be enough sun for seedlings to get established, so they contain

germination inhibitors to prevent sprouting until after the land has been cleared, and the parent plants don't bother flowering unless seedlings have a chance. None of the seeds we will be planting today are fire-dependent.

A somewhat similar climate is that called **steppe**. This climate is typical of higher-altitude regions well inland from the eastern Mediterranean Sea, northward into Russia. Almost all yearly precipitation falls as snow in winter. Water is only available to plants with the spring runoff. These plants grow rapidly with late winter rains, bloom, set seed and die back in a matter of weeks. Summers may be very hot and dry; winters are generally very cold and dry. This is the climate from which come the foxtail lily (*Eremerus*), tulips (*Tulipa*), many species daffodils (*Narcissus*) and many amazing *Iris*. These plants need hot dry summers and dry winters, with plentiful water only after they begin growing. We have trouble with these plants due to both our summer rains and, frequently, our winter rains. In North America, these plants can be grown outdoors without rain protection in a few parts of our Great Plains like western Kansas and Nebraska.

Winter-rainfall growth patterns

Mediterranean-climate bulbous plants tend to have four different bloom and seed patterns. In some cases an entire genus behaves with the same bloom pattern; in other cases, different members of one genus may have different patterns.

One pattern is to bloom in late summer before rains come, with a bare bloom stalk appearing rapidly out of the bare, dry earth before leaves appear. The plant relies on stored water in the bulb to flower and mature seed. By the time fall or winter rains arrive seeds are ripe and begin to sprout. Leaves sprout later in the season, with the rains. The plants grow through the winter, adding food and water to the bulb, and go dormant in the spring. This bloom pattern is called **hysteranthous**. Hysteranthous bulbs include some *Albuca* species like *A. spiralis*; many members of the amaryllis family like the African *Amaryllis beladonna* (naked ladies), *Brunsvigia*, *Crossyne* and *Gethyllis*, winter-rainfall *Haemanthus*, and *Strumaria*; the only Australian amaryllid, *Calostemma purpureum*, and some species of the American genera *Habranthus* and *Rhodophiala*. Other hysteranthous plants include some southern African irids in genus *Gladiolus*; some *Oxalis*; and the Asian *Lycoris*, known as spider lily or hurricane lily. The only *Lycoris* that survives here is *L. radiata*, the red spider lily. Mine are blooming as I write this. Not many desirable *Oxalis* produce seed in captivity so we won't worry about those for now. They tend to be propagated in horticulture by bulbs.

A subset of hysteranthous plants have what are known as **recalcitrant** seeds. This term applies to seeds that must sprout immediately when ripe, and cannot be stored dry for any length of time. Such seeds tend to be large and fleshy. This strategy is not limited to Mediterranean climates; many tropical plants such as mango, jackfruit and anthurium have recalcitrant seed. Many amaryllids have recalcitrant seed. Winter-rainfall amaryllid seed from South Africa is available in our Spring. In many cases the seeds sprout in transit! It is not possible to sprout and keep alive seedlings of these species during our hot weather outside, and inside under lights is a problem unless you use a lot of air conditioning. It is possible to put the box with seed in the refrigerator crisper over the summer and keep the seed viable until the fall. Other, non-hysteranthous amaryllids have flat black seeds which can be stored for some period of time.

Some Mediterranean-climate bulbs sprout leaves in the fall, then flower and produce seed from late fall through midwinter. The seed sprouts rapidly and establishes a bulb before spring. These plants often have seeds that aren't viable for very long. South African *Gladiolus* and some *Lachenalia* tend to fit this pattern. Seed of such plants needs to be sprouted within a season or two of ripening. Also, their new bulbs are prone to drying out and dying during the first summer, since they haven't had a full rainy season to grow before the first dormancy. It is important to store these young, dormant seedlings at cool temperatures during their first few dormancies.

The fourth pattern is that of spring-flowering plants. They often flower as their leaves are drying, after the rains have stopped. The remaining above-ground plant must hold enough water to ripen the seed. These seeds are accustomed to lying dormant for the whole summer before sprouting with fall rains. In South Africa, many *Lachenalia* and *Lapeirousia*, especially the ones from desert climates, fit this pattern, as do *Massonia* and *Tritonia*. There are winter-growing, tuberous sundews, carnivorous plants, from Australia! They live in areas that are marshy during winter rainfall and dry down to the tuber during the hot summer, resprouting with fall rains. We won't be planting any of these today but they can be found in the seed exchanges of the Carnivorous Plant Society. There are also winter-rainfall annual sundews from South Africa, but these are beyond our scope today as well.

Habitats of winter-rainfall bulbous plants

Bulbous plants grow in many winter-rainfall habitats, ranging from desert to seasonal grassland to winter-wet hills to beside or in seasonal streams to seasonal pools of water. An interesting example is the irid genus *Geissorhiza*, which has different species that may grow exclusively in a seasonal pool, a few inches from its edge in always-wet soil, or just above the pool on well-drained rocky rises. These habitats are completely dry in the summer. None of these habitats is hard to duplicate for us. Here in the lower Sonoran Desert we can grow many of the true desert-dwelling winter-rainfall plants so hard to grow in other parts of the world. Among these are the kalkoentje ("turkey chick" in Afrikaans) *Gladiolus* species, which have the most exotic coloration and fragrance of the genus, and some of the most spectacular *Moraea* in the so-called "peacock flower" group. Luck permitting we will have seed of some of these species for you. The seasonally-aquatic bulbs are also easy here; just use a container without drain holes.

Basic plant requirements

Air and Temperature

These plants do best with good air circulation. Because they grow during the winter when it is cool to cold, they do fine outdoors for us. In fact, most of them are much more difficult indoors due to problems with fungus and insufficient light. Our overnight frosts are not a problem for most species.

Light

Different species may grow out in the open, in rocky outcrops, in grassland or under shrubs. In cultivation most grow well with just enough overhead shade to protect them from birds (30%-50% shade cloth or 1/4" hardware cloth.) Exceptions will be noted later, but for now learn that *Lachenalia* and *Oxalis* need full sun all day if they are not to look weak and floppy, and *Oxalis* flowers will not open unless the sun is shining on them.

Soils and Nutrients

Most of the non-aquatic species grow in extremely well-drained soils but with plentiful and dependable rainfall. Soils in such habitats feature little to almost no organic matter. In cultivation, winter-rainfall bulbs look and grow best with low-organic soil mixes. Some genera, such as *Lachenalia*, are long-lived in sand or gravel, but very short-lived in potting-soil-based mixes. I am going to teach you to sprout bulbs in pure sand. I use builder's sand, since it has larger and more irregular particles than play sand. Much of southern Africa has very low phosphate content in the soil, so try and avoid phosphate-containing fertilizers. Nitrogen in low, steady amounts helps bulb seedlings grow faster and get bigger, the better to survive our long, hot summers in dormancy. This is especially true for the amaryllids that have fleshy, perennial roots, like *Brunsvigia*, *Haemanthus* and *Hippeastrum*. You will read online that nitrogen fertilizer is bad for bulbs. This doesn't apply to us, since we can grow them outdoors in good light and low humidity all winter, not in a dark and dank greenhouse. Almost all winter-rainfall bulbs are very deep-seated and have contractile roots to pull them down. This enables them to survive the long, hot summer better, and helps them avoid being eaten by animals.

Water

Many winter-rainfall bulbs come from areas with highly irregular rainfall, like ours. The western coast of southern Africa, however, receives extremely dependable winter rainfall, much more dependable than ours. These plants have evolved with a lot of rain during their growing season. Many of them have seed with lots of germination-inhibiting chemicals that must be leached out before the seeds will sprout. And all the winter bulbs grow better with lots of water. Seedlings especially cannot tolerate drying out much during their growing season. Recall that cormous plants will die unless they have been able to grow long enough to produce the next year's corm. All these reasons lead us to the conclusion that winter-rainfall bulbs should be watered heavily during their growing season.

Sprouting winter-rainfall bulb seed

Fortunately, for the most part this is very easy! I have read many different ways to do it. I will show you mine. I developed this method to compensate for the fact that I work a lot and can't look at my seedlings every day, yet they need to stay moist. Later I found other people had figured this method out before me, and it is also known as the **bog method**: I let most newly-planted seed stand in water until it sprouts. I can do this by planting in containers lacking drain holes, or by standing containers with drain holes in trays of water.

Location

Sprout these outdoors in the fall. Don't do it inside; outdoor growth is so much easier and faster. None of these need all-day sun to sprout. In fact, our winter sun and temperatures are often too much for fragile seedlings. The edge of a carport, where they get a few hour's sun, is fine, as is sprouting under 30% - 50% shade cloth. Be sure your plants are protected from birds, which are guaranteed to uproot all your seedlings if they have access.

Containers

Recall most bulbs are buried deeply in habitat. The irid genus *Babiana*, in fact, is eaten baboons, and tries to hide. They pull bulbs to the bottom of any container I use in one season. The deduction is that we should use deep containers for our bulb seed. I use standard 20oz foam cups. These are 3" wide at

the mouth and 6" deep. They don't come with drainage holes for obvious reasons, so I can use them for aquatic plants as well. I keep bulb seedlings in these containers for at least 3 growing seasons before transplanting out, unless they are known to grow fast and can be transplanted sooner. The cups last at least 4 seasons of winter sun. For most species I cut drain holes while planting and stand the cups in water. After the seedlings are well up I don't stand them in water any more. Many people in California use little tiny pots. I think this is a really bad idea here unless you can water your seedlings twice per day.

Labeling

I just write the name and my accession number on the foam cup with a ballpoint pen before I fill it. I do this in batches, indoors, at my computer, and I enter the information in my database as I write on the cups. This ink lasts at least two growing seasons perfectly well, and two more still legible. The gouges caused by the ball point can be read even years later, after the ink fades. If you prefer labels stuck in the container, go ahead, but no bird has ever pulled the writing off one of my cups.

Soil

I looked for something fast-draining, low in organic matter, but very moisture retentive. I found builder's sand, the kind sold at building supply stores or big-box hardware stores. It is intended to be mixed with Portland cement and gravel to form concrete. It has been washed and screened, is of medium and slightly varying size, and doesn't contain weed seeds. It works wonderfully for bulb seed (and other succulent seed, for that matter.) I don't use anything else. Sometimes if I know seedlings will be very tiny I top off the newly-planted pots with an inch of white silica sand, the better to see the little green sprouts. But I don't do this routinely any more because it takes extra time. This white silica sand is sold as playbox sand. Sixty pounds fills XXX cups.

Depth

None of these seeds is very large, and they won't wind up very deep in habitat. Although the bulbs may wind up quite deep, they get there by pulling themselves down with contractile roots. So don't plant bulb seed very deep. I usually put it down about 1/2 inch. Wind-dispersed seed like *Gladiolus* or flat black amaryllid seed, I barely cover. Big, fleshy, recalcitrant amaryllid seed is just placed on the surface of a very soft soil mixture and kept moist in proper season. A sprout will emerge from the seed, push into the soil, and then the first leaf will push up.

Watering

Our tap water is fine. I put the cups in plastic trays I bring home from the hospital and make sure they are standing in water all the time until the seedlings are well up. The trays last two or three seasons in the sun. You can probably find something that works just as well. If you are more meticulous than I, and you can water more often, you don't need to stand your cups in trays. I do it so they dry out slower. A big exception is genus *Gladiolus*. I have found they do not like standing in water, especially the desert ones. However, they also do not like drying out. I have to be careful with them.

Fertilizing

I use ammonium sulfate, 1 teaspoon per gallon of water, once the seedlings are well up and growing. More frequent fertilizer means faster growth and greater likelihood of surviving the first summer. If I had time I would fertilize every time I watered my bulb seedlings, but I don't. I use a low-phosphate, high-potassium fertilizer monthly if I can.

Growing on

Just keep watering and fertilizing. Watch them grow. Protect them from birds.

The steps

1. Assemble everything required: 20 oz foam cups; ball point pen; knife for making drain holes if desired; sand; scoop for sand; water; seeds; database at hand (computer or on paper)
2. Write the name of the plant on the cup as well as anything else you want to write on the cup such as accession number. At the same time enter the information into your database. Because most catalogs are online now, I usually copy all the information from the catalog into my database. (I have included all the information about the seed I ordered for this workshop in an appendix. If you receive this document as a PDF you can use the text selection tool to copy this information into your electronic database.)
3. If you are going to make drain holes, do it now. I like to insert a steak knife, vertical orientation with sharp side up, at the bottom of the cup on the side, from one side of the cup to the other, just above the bottom. Then I twist the knife about 15 degrees in each direction.
4. Fill cups 3/4 with sand.
5. Add some water so the top layer of sand is moist but there is no water standing.
6. Sprinkle the seeds on the surface.
7. Top with 1/2" of sand.
8. Gently add more water. Try not to disturb the seeds. I often use a spray bottle for this step.
9. Set the cups in your tray.
10. Put the tray where you want to keep the sprouting plants. If you are going to stand the cups with drain holes in water, or if you are going to keep the cups without holes filled with water, add the water once they are in the final location.
11. Wait for sprouts. Some sprout within a week; others will take multiple weeks. Don't give up. If they don't sprout the first year, store the cups over the summer outside in the heat but without watering, and try again the next fall. There are plants that take more than a year to sprout.

First dormancy and storage

The first summer dormancy is rough on tiny bulbs. Especially in our climate they need help to survive. This means indoor dry storage. In the spring as it heats up they will start to look weak and yellow. Stop watering and let the cups dry out completely to force dormancy. (If it's heating up and they still look green and vigorous, keep watering as long as possible.) After the soil is good and dry, put the cups in a box and store them inside your house in a closet. Outdoors the first summer dormancy is too hot you and will lose a lot of them. Fleshy-rooted amaryllids should be treated differently. Most of these are hysteranthous and have recalcitrant seed (you were paying attention when I explained these above, weren't you?) Bring them indoors when it's just starting to get warm in the spring, and try to keep them growing as long as possible in a window or under lights. It's even better if they grow all summer and through the next winter as well. The little seedlings are very hard to keep alive if their tiny fleshy roots die during the first summer. If you do store your winter-growing bulbs outdoors in the summer, be careful they don't get watered. *Lachenalia* in particular are known for dying with just one watering or rainfall during hot weather.

The next fall

I keep *Albuca spiralis* and *Oxalis meissneri* in plain view all summer on a shelf. They are the first winter bulbs to sprout for me, every year, in late summer. They remind me to go check the *Boophone*, *Haemanthus*, *Oxalis* and *Strumaria* for signs of flowering. When the above six are sprouting I put them in a sunny windowsill or outside, and start watering. When nights are definitely cool I bring out the rest of the bulbs and wait before watering. Any that begin growing or flowering get water. When days start to feel cool I give all the bulbs a good soaking and wait. The ones that start growing or flowering start getting regular watering so they stay moist. For the other ones I wait two weeks and give another soaking. When it's definitely winter I begin watering all the pots heavily, even if they haven't sprouted. They will.

Transplanting

Transplant in late summer while dormant. It is possible to transplant while growing if you are very careful, but most of these have fragile roots. A few, like *Chasmanthe* and some *Gladiolus*, grow so fast you can transplant them after the first year. Many *Lachenalia* will bloom in their second growing season. They can be transplanted the following summer. Lachs don't bloom well when crowded, so they need to be divided every 2-4 years. This leaves a lot of extra bulbs for the October Silent Auction.

For the rest I wait three growing seasons minimum, then transplant into a bigger container; usually, a much bigger container. One gallon or larger acceptable for most mature winter-growing bulbs. Most fleshy-rooted amaryllids won't bloom in pots smaller than about 5 gallons or larger. Some of them, like *Brunsvigia*, may take up to 20 years to bloom the first time. The bulb and root system need to be very large. *Amaryllis belladonna* and *Crinum* will not bloom in a pot, period. Their thick, fleshy root systems need to be very extensive.

Use a looser soil for bigger bulbs. Sand can be mixed with 50% pumice. I will add a little potting soil for species native to grasslands or boggy areas.

Produce your own seed

Many of these species are grown by less than 10 people in the USA. Get out the paint brush or the Q-tip and get to work. Donate your seed to seed exchanges.

More information

Books

Color Encyclopedia of Cape Bulbs, Goldblatt & Manning, Timber Press. A comprehensive listing, with many color photos, of all the winter-growing bulbs from southern Africa. Includes a chapter on cultivation and plentiful information on soil and water in habitat. A few new species have been discovered since publication, but this is the bible of African winter-rainfall bulbs.

Organizations

Pacific Bulb Society, PBS, pacificbulbsociety.org . Extremely comprehensive online information (the

wiki) and photos organized by genus. Online discussion group is active, with five to 20 messages per day, digest delivery option available, and is open to non-members; very beginner-friendly and welcoming. Photos cannot be posted to discussion but can be placed on wiki for all to see. Has members-only **bulb & seed exchange**, very cheap, which is also very active; the only source for many rare bulbs. Members donate their seed or bulbs. Publishes color newsletter several times per year.

International Bulb Society, IBS, bulbsociety.org . An older group, much smaller than PBS due to past political wars. Online discussion has lots of large, bandwidth-hogging photos every day, most of which I find boring. I get the digest option, with no photos. I can go see them on the Web site if I want. Most members are very friendly but some are jerks. Also has a seed and bulb exchange of extremely rare to extremely common things, but prices are sky-high. Publishes a long-running annual journal of many pages, *Bulbs*, which is why seed exchange prices are so high. A few extremely knowledgeable international professional growers belong to this group and not to the PBS.

Sources

Both societies above have lots of seeds and bulbs available.

Steven Hammer publishes a list periodically with mesembs, Haworthias, and bulbs. E-mail to sphaeroid@juno.com and request to be put on his E-mailing list.

Dylan Hannon in California sells a lot of bulbs via mail. E-mail othonna@gmail.com and ask for the current offering, as well as to be put on his E-mail list for future offerings.

Telos Rare Bulbs (telosrarebulbs.com) provided the *Oxalis* bulbs today. Owner Diana Chapman sells many bulbs from all over the world. She has a huge assortment of *Oxalis*.

Tom Glavich sells a lot of bulbs at California shows. He puts out an E-mail list severaly times a year. Write him at tglavich@sbcglobal.net or call at 626-798-2430 to be put on the list. He sells plants from his home but only by reference; tell him you heard about him from Leo Martin.

Silverhill Seeds (silverhillseeds.co.za --yes, this is spelled correctly) in Cape Town, RSA (Rod & Rachel Saunders) Hundreds of species of wild-collected seed, as well as cultivated. I get a lot of seed from them. They have everything, not just bulbs. They can supply phytosanitary certificates if needed but the Small Lots of Seed permit should be adequate (see Appendix I for more information on import permits.) They sell recalcitrant amaryllid seed, which is big and fleshy and normally sprouts as soon as it is ripe. You have to E-mail Rachel with the PDF of your permit info@silverhillseeds.co.za . Ask to be put on the amaryllid list. Before you order, mail some of your green and yellow import labels. Rachel E-mails amaryllid seed lists as seed becomes available. You must order right away. I do so via E-mail with my credit card. It arrives in a few weeks but it is 6 months out of season, since fall there is spring here. I put the package in the crisper drawer of my fridge until later. Or. if you have a cool room in the summer with a fluorescent light bench, you can sprout the seed when it arrives. They sell *Boophone disticha* and *B. haemanthoides* seed, and a lot of *Haemanthus* species, every spring, and lots of others.

Appendix I: Importing living plant material to the USA

The United States Department of Agriculture (USDA) is concerned about importing new insect, bacterial or fungus pests and invasive plants species. It is necessary to have a USDA permit to import plants from other countries. There is a list of plant species forbidden entry, usually because they are invasive or host unwanted diseases. If you import plants without permits you are breaking the law and might get caught and fined - big fines. I will give a brief overview of the system and how to get the **free** permits. You must be absolutely sure you understand the process yourself before you import anything with your permits; don't rely on my explanation alone. Read what is on the USDA Web site. Start here:

www.aphis.usda.gov/import_export/plants/plant_imports/index.shtml

There are two permits that pertain to us: the **General Import Permit (GIP)** and the **Small Lots of Seed Permit (SLOS)**. I have both and I suggest you get both if you are going to import. The African seed you are planting today came in under my SLOS permit (assuming it got here--it wasn't here as I wrote this.) Application for both can be made online at

www.aphis.usda.gov/permits/ppq_epermits.shtml

(Animal and Plant Health Inspection Service.) Look for E-Permits. You are looking for **PPQ 587 - Application for permit to import plants or plant products**. As of this writing the same application is filled out for the GIP and the SLOS permit, and you must fill out the application twice, once for each permit. You must first register and create an account with username and password. You must give your shipping address, as well as what plants you wish to import (you can import other plants as well) and which port of entry you will use. To keep it simple, on the electronic permit application, select *All permitted plants and plant parts* and *All ports of entry*. If you are mailing in a paper application, write the above phrase in where it says Plants to import and Ports of entry. After your permits are issued you can download the PDFs, which you can E-mail to your source overseas. They need to include a paper copy with shipments to you. It takes several days to two weeks for the E-permit to be issued, and they do not notify you. You must return to the E-Permits page, log in, and check to see whether your permit has been issued. When it has been issued, you are not ready to order yet. APHIS will surface mail you green and yellow labels with your permit number on them. Each of the two permits will have labels with separate permit numbers; take care to keep them separate and be sure you send the right labels for use with the right permit. You must wait for these labels and you must mail some labels to your source out of the country before ordering. One of the labels must accompany each shipment from overseas.

The GIP can be used to import any legal plant or seed. The material must be shipped to you with a phytosanitary certificate from the country of origin, a paper copy of your GIP permit, and an itemized list of exactly what is in the box. One of your green and yellow labels is supposed to be on the outside of the box. Every plant or part must be labeled. Size restrictions apply for plants. Because the label is on the outside of the box, the shipment is supposed to go first to a USDA import inspection station at one of a few airports. They inspect the shipment and ship it along to you, at your expense. Some overseas suppliers can supply phytosanitary certificates, but this is usually quite expensive. Many overseas suppliers will not or cannot supply phytosanitary certificates.

Because phytosanitary certificates are expensive and sometimes impossible to get, the SLOS permit was created. This is good for seeds only. There is information here:

www.aphis.usda.gov/import_export/plants/plant_imports/smalllots_seed.shtml

With this permit each shipment can have up to 50 seed packets with up to 50 seeds of the same species per packet, without a phytosanitary certificate. If you are importing more than 50 seeds of one species they can be split up into multiple packets of 50 or fewer seeds each. An exact itemized list of what is in the box must be included, as well as a paper copy of your permit, and each seed packet must be labeled. One of your green and yellow labels is supposed to be on the outside of the box. The shipment is supposed to go to an inspection station, then be inspected, and forwarded to you at your expense.

CITES I plants are a different story. They require an additional permit from another agency, as well as an export permit from the country of origin, and it is so difficult to import these plants I suggest you not try.

You can also use the SLOS permit or the GIP for carrying cleaned seed back from vacation but you need to carry a paper copy of your permit. (I suggest you clean the seed very well and perhaps treat it with dilute bleach or alcohol as well.) You should also have two postage prepaid mailers with you in your luggage: one with your green label on the outside that will take your seeds to the USDA/APHIS inspection station, and one from that station to your shipping address. At the airport on your return, declare you have seeds. Show them the permit. They will take the seeds and the mailers. The seeds and the return mailer are supposed to be placed in the mailer to the USDA to be inspected, then to be mailed to you if they pass. Good luck.

The importing process:

1. Go to the USDA APHIS Web site. Read about the permits. Download the lists of plants forbidden entry to the USA and also to Arizona and read it. Download the instructions for the permits. Read them and be sure you understand the requirements.
2. Go to E-Permits and register. Write down your registration information because you will need to use it in the future. Apply online for both permits, the GIP and the SLOS.
3. Log in and check every few days to see whether your permits have been issued. Download the PDFs of your permits. Store them where you can find them.
4. Wait for your labels to arrive. Be sure you know which labels go with which permit. I suggest you print out a paper copy of each permit and put the permit together with the appropriate labels in your file cabinet.
5. Contact your potential seed source. Ask them whether they are willing to accept and store some your labels for use sending seed to the USA, and follow the requirements. If they agree, E-mail them your permit PDF and surface mail them some of your labels. Ask that they E-mail you when they receive your labels. If you want to import recalcitrant amaryllid seed, recall it must be shipped immediately upon ordering, so be sure your source always has some of your labels on hand. Don't order until your source has your labels.
6. When ready to order, send them your order. Gently remind them of the paperwork requirements: For the SLOS, there may be up to 50 packets in each shipment, labeled, with one species in each packet, with up to 50 seeds per packet. A paper copy of your SLOS permit and an exact itemized list of what seeds are in the box must be included. One of your green and yellow labels must be on the outside of the box or envelope. For the GIP, in addition, a phytosanitary certificate covering all the material in the shipment must be included.
7. Wait. Sometimes it takes months and your plants or seed arrive dead. Sometimes nothing ever arrives. But usually there is no problem.

Appendix II: Some winter-rainfall geophytes

Albuca (some species) - Family Hyacinthaceae, Africa. Easy to sprout and grow. Interesting pendant flowers from upright stalks: three inner petals tightly enclose reproductive parts, three outer petals hang away at 45 degree angle. Flat black or grainy brown seeds; usually self-fertile, so plenty of seed for practice and sharing.

Amaryllis belladonna - Family Amaryllidaceae, Africa - hysternanthous and recalcitrant. They will grow here in the ground and bloom every few years or so in the fall. Need summer watering every 2-3 weeks if no rain or they won't bloom (but do not water more often in the summer.) Will not bloom in pots. If yours bloom and you hand-pollinate them you will get viable seed, which must be planted on the surface of soft soil in the fall and kept moist. Large fleshy roots; buy South African seed in the spring, store in the crisper until October, and grow outside in winter. Try to keep growing the first summer indoors under lights or in a window.

Androcymbium (some species) - Family Cochicaceae, Africa. "Men-in-a-boat." Unusual or pretty rather than extremely beautiful, but interesting.

Babiana - Family Iridaceae, Africa. "Baboon flower." Lots of small to big, pretty species, many with great fragrance. All like lots of water. Many are ditch growers. When replanting, be careful to stand bulbs upright; many will sprout in whatever direction they point, rather than correcting themselves to sprout upright.

Bessera - North America (Botanists move this back and forth between families.) One is native to Sonora and has bright red flowers.

Boophone (some species; some grow in both summer or winter rainfall areas) - Family Amaryllidaceae, Africa - hysternanthous. See *Amaryllis* for sprouting info. Very poisonous. Require very large pots so the big roots don't dry out over summer.

Brunsvigia (some species) - Family Amaryllidaceae, Africa - hysternanthous. Seed available from Silverhill in season. Summer and winter growers. See *Amaryllis* for sprouting info. Require very large pots so the big roots don't dry out over summer.

Bulbine (some species) - Family Hyacinthaceae, Africa. Very easy to grow.

Bulbinella (some species) - Family Hyacinthaceae, Africa. Very easy to grow. Has enlarged roots, not true bulbs. Needs a little summer water and indoor temperatures to survive dormancy.

Calochortus - North America (Some in AZ) (Botanists move this back and forth between families.) "Mariposa Lily." Amazing plants, including three native to AZ. Many are easy here.

Calostemma purpureum - Family Amaryllidaceae, Australia - hysternanthous. Interesting but easy-to-grow. May not go dormant in summer especially if kept in house. I got mine from Telos. Require very large pots so the big roots don't dry out over summer.

Chasmanthe - Family Iridaceae, Africa. Looks like a big florist's hybrid glad. Grow very fast and may bloom the first year from seed, so consider using a 5-gallon pot for planting seed. Lots of water.

Colchicum - Family Colchicaceae, Europe, Middle East - hysternanthous. "Autumn Crocus", **C. sativum**, is source of culinary saffron. They grow fine here if dry in summer. True **Crocus** are in the iris family and need colder winters than ours. Try growing **Romulea** for close **Crocus** relatives that do fine here.

Crinum (one rare, winter-growing species, **C. variable** from S. Africa, and many summer-growers) - Family Amaryllidaceae, worldwide - many hysternanthous. One of several different plants sometimes called "spider lily." Silverhill, PBS and IBS are sources of seed. See **Amaryllis** for sprouting info but realize most are summer growers. Almost impossible to flower in containers; even a 15-gallon is too small. Do fine in the ground here.

Crossyne (some species) - Family Amaryllidaceae, Africa - hysternanthous. See **Amaryllis** for sprouting info. Require very large pots so the big roots don't dry out over summer.

Cyanella - Family Tecophilaceae, Africa. Beautiful and easy.

Daubinya - Family Hyacinthaceae, Africa. WOW! Brilliantly-colored, waxy flowers. Easy from seed. Silverhill sells it.

Dichelostemma - North America (Some in AZ) Including our "Blue Dicks", **D. capitatum** (old name **D. pulchellum**.)

Drimia (some species) - Family Hyacinthaceae, Africa - often hysternanthous. Easy. Tiny to large species; short to tall spikes of flowers. Many genera have been lumped in here including **Schizobasis** and **Urginia**. Big ones need very big pots to bloom.

Eriospermum (some species) - Family Convallariaceae (the lily-of-the-valley family), Africa. Seed not viable long; plant the first fall after you get it. Often very late to emerge in the fall.

Ferraria - Family Iridaceae, Africa. Easy. Often fragrant. Best in 1-gallon pots or larger.

Freesia (some species) - Family Iridaceae, Africa. Easy. Often wonderfully fragrant.

Geissorhiza (some species) - Family Iridaceae, Africa. Some easy; some hard. Very beautiful flowers.

Gethyllis - Family Amaryllidaceae, Africa - hysternanthous. See **Amaryllis** for sprouting info. Very small seed, however, and some people sprout them as soon as they arrive in the spring from Africa, keeping the sprouting room as cool as possible. Plant looks like a sea anemone with a single, spotted leaf sheath enclosing many thin, often curly leaves. Needs a large pot.

Gladiolus (some species) - Family Iridaceae, Africa - often hysternanthous. Some easy; some hard. The desert ones ("turkey chicks") are beautiful, different, and very fragrant. (**G. alatus**, **ceresianus**, **equitans**, **venustus**, **viridescens**, **watermeyerii**, and others.) Don't tolerate standing in water and need

good drainage.

Haemanthus (some species) - Family Amaryllidaceae, Africa - often hysteranthous. See ***Amaryllis*** for sprouting info. Need large pots and indoor summer storage.

Hippeastrum (a few species; most are summer growers) - Family Amaryllidaceae, South America - often hysteranthous. This is the florist's "amaryllis." Flat black seeds; sow on surface of soil and keep very moist. Or float on surface of water until sprouting and transplant. Contrary to what you have been told, they need big pots, they **do not like to be rootbound**, they need an almost pure inorganic soil mixture which is light and drains fast (think pumice/sand), the bulb must be planted so the equator is well out of the soil with only the roots buried or it may not bloom, they need lots of fertilizer, and they will not flower for several years if you cut off or kill their roots.

Hypoxis (some species) - Family Hypoxidaceae, Africa. Fibrous roots rather than true bulbs, but beautiful flowers.

Iris (some species) - Family Iridaceae, Middle East and Europe. Seed may need to be planted in moist soil and refrigerated for 6 weeks before bringing out into fall weather to sprout.

Lachenalia - Family Hyacinthaceae, Africa. "Cape Hyacinth". Incredible range of colors; some very fragrant. Easy. Divide and repot often. Full sun and letting dry between waterings prevents floppiness. Don't let dry in bud. Use a deep pot.

Lapeirousia (most species) - Family Iridaceae, Africa. Miniatures with brilliant flowers. We can easily grow ***L. oreogena***, one of the most brilliant and best, and other people struggle.

Massonia - Family Hyacinthaceae, Africa. Easy. Tolerates being frozen like a popsicle. Use a 1 gallon or larger pot for huge plants!

Moraea (some species) - Family Iridaceae, Africa. Many are easy; many are really beautiful. Tiny to large plants; flowers white to purple to yellow.

Ornithogalum - Family Hyacinthaceae, Africa to Asia. Easy. Sometimes short-lived, so save seed. Tiny to large plants.

Oxalis (most species) - Family Oxalidaceae, worldwide (Some in AZ) - some are hysteranthous. Do not let them dry out after they sprout or they will go dormant until the next fall--if they survive. Must have sun shining on the flowers to open. Bigger pots lead to better plants and better flowering. 1 gallon is not too big.

Oziriöe - Family Hyacinthaceae, Chile. Delicate and pretty, not showy.

Polyxena - Family Hyacinthaceae, Africa. *Lachenalia* relatives; many with strong fragrance.

Rhodophiala (some species) - Family Amaryllidaceae, South America - hysteranthous. ***R. bifida***, in many colors, survives outdoors here in an irrigated bed, flowering every September with small "amaryllis" type flowers. Commonest color is deep red. Flat black seed is easy.

Romulea (most species) - Family Iridaceae, Africa through Europe. Mostly very easy. Look like miniature **Crocus** but some have amazing flower colors. Some are aquatic.

Strumaria (some species) - Family Amaryllidaceae, Africa - hysternanthous. See **Amaryllis** for sprouting info. Small seeds. Need a deep pot.

Tritonia - Family Iridaceae, Africa. Miniatures, easy to grow in the desert. Flower as the leaves dry out. Stop watering when flowers open and allow to go dormant.

Veltheimia (two species) - Family Hyacinthaceae, Africa. Both species do best here with some shade and some summer water. Easy from seed. These are big plants that need big pots.

Whiteheadia bifolia - Family Hyacinthaceae, Africa. Huge round pair of leaves with a green, skinny-pineapple-like inflorescence. Amaze your friends. Shade. Big pot for best display.

Wurmbeya (some species) - Family Cochicaceae, Africa, Australia. Interesting and pretty, sometimes with strange smells.

Zantedeschia (most species) - Family Araceae, Africa. "Calla lily." The big white one (**Z. aethiopica**) is actually aquatic but performs OK in moist soil rather than standing water. The other species and hybrids aren't winter growers and aren't aquatic. The summer-growers don't like heat, though, so they are house plants here.

Appendix III: Catalog descriptions of plants ordered for this workshop and some others perhaps from Cliff and Leo

I have put my comments into brackets like [this]

From Telos Rare Bulbs:

Oxalis purpurea Large flowers in a wide range of brilliant colors. Foliage can be extremely variable. Zone 8-10.

7570 **Oxalis purpurea** Cherry: Beautiful deep cherry red flowers on compact plants.

7520 **Oxalis purpurea** Pink: Large deep pink flowers on compact plants.

7540 **Oxalis purpurea** White: Bright lustrous white flowers on 4" tall plants.

Oxalis growing instructions shipped with Telos order:

Special Planting Instructions: Oxalis

Oxalis bulbs should be planted in a mix that is low in organic material. The specific ingredients are less important than adding sufficient sand, gravel, pumice or perlite to the mix. The mix used at Telos is about 50% ground fir bark and 50% pumice or perlite. Repotting is recommended every two years, and a very light fertilization with a dilute liquid fertilizer about once a month during the growing season. Care should be taken they do not dry out during the growing season, since this can cause premature dormancy. When the plants go fully dormant in the spring, they should be kept completely dry throughout the summer. Watering can commence in the Fall.

To grow and bloom well, oxalis require good light, with as much sun as possible. In low light situations they can become etiolated (drawn out and floppy), and will not bloom. Sun is needed to open the flowers.

Oxalis bulbs are often symmetrical, with no obvious top or bottom. It is recommended, therefore, that most oxalis bulbs be planted on their sides. Some oxalis bulbs, such as *Oxalis flava*, are an obvious pear shape, and these should be planted rounded side down.

It is important that oxalis have a warm dormancy, or they may fail to sprout in the Fall. The minimum recommended storage temperature during the summer is 70 degrees Fahrenheit. Higher temperatures will not harm them. They will sprout in the Fall in response to dropping temperatures. [Leo adds: Use all light-colored material in your Oxalis potting mix because the often-tiny bulbs are the same color as most potting soil! Pure sand works just fine, but they need fertilizer.]

Catalog listings from Silverhill for seed I ordered for this workshop:

Androcymbium latifolium (old name *A. pulchrum*) Prostrate hairy lvs, wine-red fl bracts with green markings below, fl Wi-Sp. Sow Au. Zone 8.

All *Babiana* listed are Wi-growing and Su-dormant unless otherwise specified. Grow them all in deep pots. All are Zone 8.

Babiana ambigua 4-8cm, large scented blue fl with white/yellow markings in Sp. Sow Au.

Babiana odorata 5-12cm, yellow strongly scented fl Sp. Sow Au.

Freesia fucata Erect leaves to 30cm, showy spikes of bicoloured yellow and cream very sweetly scented fl. Sow Au. Zone 8.

All the *Gladiolus* species listed below are Wi-growing and Su-dormant and are from Zone 8 unless otherwise specified.

Gladiolus alatus 20cm, scented orange fl, lower lobes yellow to lime-green Sp, well-dr soil, sun. Sow Au.

Gladiolus watermeyeri 10-30cm, ribbed lvs, striking scented cream to grey fl with purple veins & green & orange markings Wi-Sp. Sow Au.

[Doug Dawson showed *G. equitans* at the September 2010 meeting and everybody said OOOHHH! Silverhill usually has that but not right now. The two I ordered are turkey-chick relatives]

All the *Hesperantha* species listed below are Wi-growing and Su-dormant and are from Zone 8 unless otherwise specified.

Hesperantha vaginata 15cm, yellow fl with black markings in Sp. A rare & very beautiful species. Sow Au. [Most people find this hard to grow but it does just fine for me! It shines like a tulip in the sun. Different plants have more or less black on petal tips and in the throat.]

All the *Lapeirousia* species listed below are Wi-growing and Su-dormant and are from Zone 8 unless otherwise specified.

Lapeirousia oreogena 7cm, striking violet fl with cream markings Sp. Sow Au. [A tiny plant with a cloud of amazing neon-blue-violet flowers bearing white and black chevrons. Everybody who sees one in bloom has to have it. Easy for us to grow--I'm on the third generation-- but most people struggle with it. I think it needs hot dormancy.]

All the *Moraea* species listed below are Wi-growing and Su-dormant and are from Zone 8 unless otherwise specified.

Moraea aristata 20-35cm, large white fl with blue nectar guides Sp, lovely pot plant. Sow Au. [One of the peacock moraeas. Extinct in habitat but in cultivation since the 1600s. Large nectar guides at the base of round, pure glistening white petals are blue-black with a rainbow iridescence in the sun.]

All the *Ornithogalum* species listed below are Wi-growing & Su-dormant & are from Zone 8 unless otherwise specified.

Ornithogalum maculatum 8-50cm, orange or yellow fl, outer petals with dark tips Sp. Sow Au. Seeds of a dark orange form available. [Ornithogalum tend to be short-lived, so save seed.]

Romulea The nearest ally to this genus is the *Crocus*. The flowers, mostly on short stalks, come in a wide range of colours, and are from an equally wide range of habitats. Almost all are worthy of cultivation. All the species listed below are Wi-growing and Su-dormant.

Romulea monadelphica 12-40cm, striking deep red fl with black throat Sp, one of the "large reds". Sow Au.

Romulea sabulosa 12-40cm, red fl marked yellow and black Wi-Sp, dry. Sow Au.

[Both these have blinding red flowers. There are many other flower colors in Romulea, all easy.]

All the *Sparaxis* species listed below are Wi-growing & Su-dormant & are from Zone 8.

Sparaxis tricolor 10-40cm, striking orange/salmon-pink fl with yellow & black centre Sp. Sow Au.

Veltheimia bracteata 25-60cm, Wi-growing, undulating leaves in rosette, raceme of pendulous cylindrical pink fl Sp, easy, shade or s/shade. Sow Au. Zone 8.

The following is a non-bulb, actually a shrub/perennial in family Sterculiaceae (along with chocolate and *Brachychiton*, the bottle trees) and is related to the knee-high North Cape shrub with beautiful red flowers that Doug showed at the September meeting, *Hermannia stricta*:

Hermannia desertorum Perenn to 30cm, yellow & orange twisted bell-shaped fl Su, very drought resistant & palatable to stock. Sow Au. Zone 8.

Seed or bulbs Cliff or Leo might bring, most originally from Silverhill

Albuca navicula [From Steven Hammer. Emerging leaves shaped like the prow of a canoe; ciliate leaf edges. Tall stalks of green and yellow flowers. New to cultivation.]

Albuca sp [Easy grower from seed. Makes lots of yellow & green flowers. From Pacific Bulb Society bulb exchange.]

Babiana sinuata To 10cm, contorted wavy leaves, pale mauve fragrant fl with greenish tubes Sp, unusual. Sow Au. [This gets taller. Fragrance is great. Flowers are small but there are lots of them. It reseeds gently if allowed and is very easy to grow. Leo has brought it in flower to meetings]

Daubenya aurea - red form 2-4cm, Wi-growing, 2 ovate leaves flat on the ground, bright red fl Sp, sun, well-dr soil. Sow Au. Zone 6. Seeds very limited. [Flower looks carved from blinding red wax.]

Lachenalia alba 15cm, showy white fl late Sp, very showy plant from near Nieuwoudtville. Sow Au. [Bigger than stated, sturdy stalks of many, many pure white flowers]

Lachenalia aloides var quadricolor 9-20cm, reddish-orange, yellow & green fl with purplish-maroon tips Wi. Sow Au. [Cliff has brought this in flower to meetings]

Lachenalia contaminata 6-25cm, grass-like leaves, widely open white fl with maroon markings Sp, does well in pot. Sow Au. [Leo has brought this in flower to meetings. Leo got some of his from Steven Hammer and some from Silverhill]

Lachenalia rubida 6-25cm, fl often before leaves, pendulous pink to ruby-red fl often speckled Au-Wi. Sow Au. [The first one to bloom in the fall]

Lachenalia unicolor 8-30cm, pustulate green/maroon leaves, very variable fl Sp, white & blue, floriferous & showy. Sow Au. [This strain has electric blue and purple flowers]

Pelargonium incrassatum 30cm tuberous perenn, decid pinnately incised lvs covered with silky hairs, brilliant pinkish-purple fl in pseudo-umbels Sp, pot. Sow Au. [Leo has brought this in flower to meetings. It actually flowers continuously from midwinter to the arrival of heat. Hand-pollination leads to plenty of seed production. It will probably flower this spring for you. Succeeding years bring more and more flower heads as the root enlarges]

Whiteheadia bifolia 8-12cm, Wi-growing, prostrate leaves, white fl in dense spikes Wi-Sp, Namaqualand. Sow Au. Zone 8. [This is really weird but everybody who sees one wants it. It needs some shade even in winter. In habitat it grows in the wet shade of boulders]

Notes