OSTEOSPERMUM CULTIRE GUIDE

June 2019

ABSTRACT

Often referred to as Cape Daisy, Osteospermum features beautiful daisy-like flowers in various shades including pink, purple, white and yellow. This Osteospermum Culture Guide presents information on propagation, transplanting, fertilizer requirements, temperature, growth regulation, diseases, pests and scheduling.

Bob Croft

Propagation

Rooting Material:

Select a sterile, porous and well-aerated material for optimum rooting. Good aeration is important for preventing soft rots such as Pythium and Rhizoctonia and allows for more controlled growth during the later stages of propagation. Foam, peat, rockwool and media blends with 30-40% aggregate are all good choices. Target the media pH between 5.5 and 6.2 and the EC at less than 0.75 mmhos (1:2 slurry).

Cuttings:

It is important to purchase cuttings from a reputable source that uses certified virus free mother stock and best practices for sanitation, disease and insect control. When cuttings arrive, inspect them immediately by opening the box in a shaded sterile area to avoid exposing cuttings to insects. Cuttings should be held in a cool, shady area or refrigerator at 45-50°F/7-10°C until stuck. To maintain freshness, remove small quantities of cuttings at any one time. If leaving overnight, open the box and allow the cuttings breathe and prevent moisture build up. Do not expose the cuttings to temperatures below 41°F/5°C, or higher than 60°F/16°C.

Stage One: sticking to callus (Days 1-10)

Cell Size – 3/4 to 1½ inch / 20 to 38 mm

Stick cuttings into a pre-moistened rooting medium. For best results use a rooting hormone with up to 3,000 pm of IBA. Mixtures that also include up to 500 ppm of NAA work well too.

To reduce leaf surface tension and maximize water delivery to freshly stuck cuttings, apply a spreader sticker to the cuttings a day following sticking. CapSil 30 adjuvant works well at 3-4 ounces per 100 gallons/24-32 ml/100 liters, to reduce stress from transport and sticking. Follow all label directions.

Maintaining a slightly higher media temperature (+ 5°F) than the ambient air will encourage callus and root development faster than shoot growth. However, bottom heat may promote stretching of Osteospermum so it is only recommended for Stage 1. Osteospermum roots best at a media temperature between 65-68°F/18-20°C. Optimum light level for propagating Osteospermum is 1,500-2,000 foot candles/ 16,000-22,000 lux. Osteospermum do best with more frequent short bursts of mist than other crops. Mist regularly the first 10 days or until callus formation and then apply mist only as needed to keep the cuttings turgid. Frequency of misting is highly dependent upon light and temperature and should be adjusted as conditions change. If using bottom heat in Stage 1, overnight misting is recommended to prevent excess drying. By day 12 the cuttings should no longer require mist.

Growing Tip: Take care not to over-saturate the media until root formation. Excess media moisture results in uneven rooting and growth with yellowing of the growing tip.

Stage 2: root emergence (Days 11-17)

Osteospermum cutting with callus

Once roots start to emerge, raise the light level to 3,000-3,500 foot candles/32,000-38,000 lux to speed development and prevent stretching. Reduce air humidity to 70-80% and target a day and night temperature of 68°F/20°C with a two hour morning temperature drop, (5-7°F/2-3°C) beginning at dawn. Maintaining as close to a 0° DIF (difference between the day and night temperature) as possible with morning temperature drop reduces stretching and promotes compact cuttings. In addition, sprays of B-Nine (daminozide) or Cycocel (cholormequat) may be applied weekly after callus formation to prevent stretch.

Chemical	Rate	B-Nine/Cycocel Tank Mix*
B-Nine	2,500 ppm / 0.25%	2,500 ppm / 1,000 ppm
Cycocel	1,500 ppm	

*stronger effect and best for vigorous types, like Crescendo

When roots form, apply 75 ppm nitrogen from a well-balanced calcium nitrate-based formulation to strengthen the plants and enable them to tolerate higher light levels.

Growing Tip: Take care not to harden the cuttings too quickly as this delays rooting and decreases branching post-transplant.

Osteospermum with root emergence

Stage 3: bulking (Days 18-24)

Once roots have formed, allow the plants to dry down somewhat between irrigations. Keeping the media too wet promotes disease and a hydroponic root that is less able to supply the plant with water and nutrients once transplanted into containers. Fertilize with 100-150 ppm N and target an EC of 0.75 mmhos.

***Pinching**:*

We do not recommend pinching until after transplanting to the pot/container as the strongest and most consistent branching occurs after plants are established in the final container.

Stage 4: toning (Days 25-30)

Osteospermum roots easily and should be ready for transplanting in 3 weeks, 4 weeks maximum. As the liners reach the transplant stage, allow them to dry down between watering to tone and prepare them for transplanting. Do not delay

Osteospermum showing strong root emergence

transplanting as Osteospermum is a strong grower and undesirable stretching will occur. Should the liners need to be held, lower the temperature to 55-60°F/13-16°C and apply a chemical plant growth regulator as needed.

Diseases - Propagation

Rhizoctonia solani (fungal root rot) is a natural fungus that causes diseases such as damping-off, root rot, crown rot, stem cankers, and web blight. *Rhizoctonia* is a main concern for growers who direct stick Osteospermum into containers or use poorly aerated media. The fungus characteristically grows across the top of the soil to attack the stem base. Keep hose-ends off floors as *Rhizoctonia* can persist in dirt and debris on concrete floors. Fungus gnats and shore flies may also introduce and spread this fungus within a crop. Biological and chemical methods are available for controlling these insects. Sanitation is always the first defense against *Rhizoctonia*. Use sterile, soil-less growing medium, clean pots and flats, and keep field soil away from propagation areas. If preventative drenches are necessary, select those labelled as safe for use on Osteospermum. Fungicides with active ingredients such as thiophanate-methyl (Banrot), strobilurins (Heritage, Compass, Insignia), and PCNB (Terraclor) are effective in combatting *Rhizoctonia*. Biofungicides containing Trichoderma or Bacillus subtilis, are also helpful in fighting this pathogen.

Insects - Propagation

Fungus gnats and shore flies can be a problem if algae are present in the propagation area, on floors, walls and/or benches. Heavy infestations of fungus gnats and shore flies can negatively affect rooting and quality. Eliminate algae and weeds by thoroughly scrubbing the propagation area with bleach and eliminating standing water.

Fungus Gnats (*Bradysia* spp.) and shore flies can be a problem if algae are present in the propagation area, on floors, walls and/or benches. Heavy infestations of fungus gnats and shore flies can negatively affect rooting and quality of Osteospermum. Larvae cause direct plant injury to roots and create wounds that may allow secondary soil-borne pathogens to enter. Both the adult and larval stages are capable of disseminating and transmitting diseases.

Fungus gnat adults live for 7-10 days and females deposit 100 to 200 eggs into the cracks and crevices of the growing medium. A characteristic diagnostic feature of fungus gnat larvae is the presence of a black head capsule. Larvae are generally located within the top 1 – 2 inches / 2.5 to 5.0-cm of the growing medium. However, they can also be found in the bottom of containers near drainage holes. The life cycle, from egg to adult, can be completed in 20 to 28 days, depending on temperature.

Proper sanitation such as removing weeds, old plant material, and old growing medium can reduce fungus gnat populations. Weeds growing underneath benches create a moist environment that is conducive for fungus gnat development. Remove weeds either by hand pulling or employing herbicides and most importantly eliminate the build-up of algae. Excess watering and over fertilization of plants create favorable conditions that promote algae growth. Keep floors, benches, and cooling pads free of algae by using a disinfectant containing quaternary ammonium salts.

Insecticides combined with algae control works best to control populations. Options include conventional insecticides (adults) insect growth regulators (larval stage) and microbially-based insecticides applied as drenches or “sprenches” to control larvae.

Fungus gnat larvae

Biological control is another option to manage fungus gnats when growing SuperCal. Biological control agents or natural enemies that are effective in controlling fungus gnats are the beneficial nematode, *Steinernema feltiae*, the soil-predatory mite, *Hypoaspis miles*, and the rove beetle, *Atheta coriaria*. All three biological control agents attack fungus gnat larvae. They can be applied to the growing medium or soil in the floor. They need to be applied early before fungus gnat population’s build-up.

Note: The Crescendo series is more easily affected by fungus gnats as they have more soft tissue and is preferred by the insects over Side Show and Cape Daisy types.

Transplanting

Media

Osteospermum does best in a media that is stable and well-aerated. High porosity mixes, such as those made from coarse/ long fiber peat moss or short fiber peat moss blended with 30-40% aggregate work very well. For containers that will not be re-transplanted, such as hanging baskets or large patio pots, a media with higher water holding capacity is desirable for consumers. Optimum pH for Osteospermum is 5.5 to 6.5 with a starting EC of 0.75 mmhos (1:2 slurry).

Containers

Osteospermum works well in a wide range of containers. Use the chart below as a guide.

Container Size	Number of Liners
4 - 6 inch/10 - 15 cm.	1
8 inch/20 cm.	3
10-12 inch/25-30 cm. Hanging Baskets	3-4
16 inch/40 cm.	5-6

Temperature

Establish the crop at an average temperature of 66°F/19°C with 62°F/17°C nights and 70°F/21°C days.

Pinching

When the plants are established with a good root system, make a soft pinch to promote branching. Avoid making a hard pinch

Pot Size	Group (Europe)	Number of nodes
4 inch / 10 cm.	Fast N'Easy	4-5
6 inch / 15 cm. and larger	Mediterranean Delight	6-7

Cooling

For 1½-3 inch/4-7.5 cm. and smaller pots, begin cooling immediately after pinching. For larger containers wait until the side branches are about 1 inch/30 cm. long to build sufficient plant body. Lower the temperature to promote high bud count and a tight flowering window. Ideal day temperatures are 55-60°F/13-16°C with nights between 40-50°F/4-10°C. Allow 2-3 weeks, depending on series and container size, for flower bud induction. Suggested growing schedules are presented at the end of this document.

Note: Sakata's Crescendo, Side Show and Cape Daisy Zanzibar series require less cooling and will produce abundant flower buds if the temperature is kept between 55-65°F/13-18°C.

Light Level

Bright light is ideal for this crop. Provide a minimum of 5,000-6,000 foot candles/53,000-64,000 lux. Osteospermum is not photoperiodic but does flower quicker under high light and long day conditions. In low light areas supplemental light is beneficial for early spring flowering.

Growing Tip: Plants that are subject to excess shading (<3,500 foot candles/38,000 lux) from overhead basket lines will flower later, produce less flowers and develop unwanted stretch.

Watering

To establish a quality plant with a strong root system, be careful not to initially over-saturate the media which slows root development. In addition, allow the media to dry down in between irrigations to promote root growth. Once established, do not allow excessive drying which results in damage to foliage and flowers. Watering early in the day is best; especially if watering overhead.

Fertilizer

10-14 days weeks after transplant begin feeding with a complete, balanced fertilizer at 200 - 250 ppm Nitrogen (constant liquid feed / CLF). The optimum EC is 0.75 – 1.0 (1:2 dilution). Alternate with calcium nitrate on a regular basis and provide a complete minor element program. The use of Osmocote® or other appropriate slow-release fertilizer products may be beneficial in supplementing a CLF program, especially if growing under field conditions, and may provide improved performance for the consumer. Cape Daisies may turn yellow along leaf margins if excess

sodium is present in water supply or fertilizer mixes. Additional calcium can help counter these symptoms. Provide periodic clear water applications if excess soluble salts accumulate.

Cal/Mag formulations such as 13-2-13, 15-5-15 and 17-5-15 work well to supply valuable calcium and magnesium. Do not apply fertilizer during the heat of the day or when plants are drought-stressed. The growing media should be routinely tested every two weeks to monitor EC and pH levels.

pH – High pH (>6.5) increases the risk of iron deficiency characterized by interveinal chlorosis of the newly formed leaves. Iron is an immobile element and symptoms will spread to the lower foliage if the pH is not corrected. Apply iron sulfate drenches, (avoiding contact with the foliage), or iron chelate sprays or drenches. Avoid applying high amounts of ammonium under cool soil temperatures and low light conditions to prevent ammonium toxicity.

Osteospermum with iron deficiency

Magnesium is a macro element and often undersupplied in commercial fertilizer mixes. Magnesium is a mobile element, so a deficiency shows as chlorosis of the lower leaves. If not corrected, chlorosis will lead to necrosis. Magnesium deficiency is easily corrected by adding MgSO4 (Epsom Salts) to the fertilizer.

	Amount of MgSO4	PPM Magnesium /Sulfur
Per 100 gallons (USA)	1 ounce (by weight)	7.5 ppm Mg / 10.5 ppm S
Per 100 liters	7.5 grams	7.5 ppm Mg / 10.5 ppm S

Osteospermum with magnesium deficiency

Growing Tip: Although visual symptoms are helpful, periodic testing of the substrate by a certified lab is the best way to manage pH and plant nutrition.

Potassium, Calcium and Magnesium Balance:

Supplying Potassium, Calcium and Magnesium at a 4:2:1, (4 K : 2 Ca : 1 Mg) promotes healthy root and flower development. Below is a chart outlining how to supply this ratio using single element fertilizers. Growers should target this balance based on an analysis of their irrigation water and substrate testing.

4 : 2 : 1	KNO3 Potassium Nitrate	CaNO3 Calcium Nitrate	MgSO4 Magnesium Sulfate	Total N-K-Ca-Mg
Per 100 gallons (U.S.A.)	5.9 ounces	6.2 ounces	5.3 ounces	130-160-80-40
Per 100 liters	44 grams	46 grams	40 grams	130-160-80-40

Phosphorous:

Phosphorous is a mobile element and the general recommendation for Osteospermum is to supply 10-20 ppm at each fertilization. Higher phosphorous rates promote luxuriant growth and compete with iron. When phosphorus is deficient, the lower leaves take on a reddish-purple color. Growers who use mineral acid to neutralize alkalinity may need to use a combination of phosphoric and sulfuric acids to avoid oversupplying phosphorus. 20-10-20, popular with many North American growers, may be alternated with 15-5-15 to maintain optimum pH but note that it does not supply calcium and at 200 ppm N supplies 44 ppm (parts per million) of phosphorus.

Micro-elements are needed in smaller amounts but are important for optimum plant growth. Provide a standard amount of trace elements to Osteospermum, similar to what you would supply to petunias, impatiens walleriana and marigolds.

Spacing

Initially, keep plants pot tight and then space when leaves begin to touch neighboring plants. Failure to space on time results in stretched plants with thin stems.

Pot Size	Space Recommendation
4 inch/10 cm.	6 in./15 cm. on center
6 inch/15 cm. or 1 gallon/4 liter	14 in./35 cm. on center
8 inch/20 cm.	18 in./45 cm. on center
10 inch/25 cm.	24 in./60 cm. on center
12 inch/30 cm. – Hanging Baskets	28 in./70 cm. on center

Plant Growth Regulation

Cold temperatures and high light are the best control methods for preventing stretch. Options include drenching prior to cooling or spraying from pinch through visible bud. Use high light, cool temperatures and a slight negative DIF for optimum growth control. Avoid spraying when flower buds appear.

Spray options

Chemical	Rate	When to apply
B-Nine (daminozide)	2,500 ppm / 0.25%	During the first 3-4 weeks after pinch. Later applications may alter flower color
Cycocel (chlormequat)	750 ppm	Make the first application 1 week after pinch when the shoots are 1 inch / 2.5 cm. long. Repeat 2 and 4 weeks later, or as needed to control stretch.

Drench options

Chemical	Rate	When to apply
Cycocel*	1,500 – 2,500 ppm	When side shoots are 1 inch/30 cm. long. Wait one week after application before starting flower induction/cooling.
Bonzi**	1 - 3 ppm	

*avoid late drenches with Cycocel as it may cause chlorine burn. Instead use Bonzi at ½ rate.
**Bonzi is best for more vigorous types / Crescendo.

Growing Tip: For outdoor production under cool temperatures, apply lower rates to avoid over regulation as temperatures are hard to predict, especially in spring.

The following cultural controls should also be implemented to compliment and reduce the cost and use of chemicals.

Cultural Control	Method
High Light	**>** 5,000 foot candles / 53,000 lux
Water Stress	Allow the media to dry down prior to watering
Low temperature	40-55°F / 5-13°C (once established)
Spacing on time	See chart under spacing

For hanging baskets, where foliar applications are impractical a drench to the point of drip is best to avoid treating plants growing on benches below. As mentioned earlier, it is best to make two applications at a lower rate to avoid overregulation; especially since hanging baskets are often watered after a slight wilt is noticed.

In those countries in which Cycocel is not registered for use on ornamentals, the following alternative chemicals have proven to effectively regulate plant growth and size with Osteospermum used as foliar spray applications:

Dazide: 0,3%
Caramba: 0,05-0,1%
Carax: 0,05-0,1%
Regalis 0,025%

Disease

Osteospermum is prone to both foliar and root disease issues. Proper watering, good sanitation practices and preventative care is the best defense. Major diseases include *Botrytis cinerea* (gray mold) and *Crown rot*.

Botrytis

Botrytis cinerea is mainly an issue when high humidity and decaying tissue are both present. Only five hours of a water film (such as that caused by condensation) are needed for infection to take place if temperatures are between 64-77°F/18 -25°C. *Botrytis* blight is likely to attack flower petals so plants in flower or those growing underneath lines of flowering hanging baskets are most at risk. The spots caused by *Botrytis* are large and irregular with tan to brown areas. *Botrytis* is also a concern when plants are not spaced properly to allow sufficient light penetration and air circulation. The lack of light causes lower leaves to senesce which then serve as hosts for inoculation.

Botrytis infection at plant base

Sanitation and environmental control are the best tools for keeping *Botrytis* in check. Remove all dead or dying plants or plant parts, and lower humidity levels. Water overhead early in the day to avoid prolonged periods of leaf wetness. It is important not to leave open containers of plant debris in the greenhouse. Heat and vent to reduce excess humidity and provide good air movement to prevent water condensation on leaves. Products containing the active ingredients fenhexamid (Decree), iprodione (Chipco 26019), chlorothalonil (Daconil), and copper (Phyton 27, Kocide) are good options in managing this disease. Please note that chlorothalonil and coppers may damage open flowers. Biological include *Streptomyces* (Actinovate), *Bacillus* (Cease), and *Trichoderma* (Plant Shield).

Crown rot

Crown rot is a disease that affects many different plant species and targets the area where the stem joins the root. Among the most prominent crown rots is caused by *Phytoptha sp.* Although Phytopthora is often referred to as a fungus, it is actually a member of the Protista Kingdom (neither animal, plant or fungus). Fusarium is a true fungus, and a common cause of crown rot along with other fungal species and sometimes the condition is linked to bacteria

and nematodes. When a plant is attacked by crown rot, symptoms appear quite quickly with discoloration of leaves and wilting. The plant eventually dies as the disease effectively separates the plant from its roots.

Phytopthora can become a chronic problem when recirculating irrigation systems are used. Treating the water with copper ionization has been successful in some cases. However, please note that chelates in the fertilizer (typically iron chelates) inactivate the benefit of adding copper. Fungicides are effective if the causal agent is a fungus.

Prevention is the key to managing crown rot and starts with using a well-aerated, sterile media. In addition, good watering practices are important as over saturating the media and or keeping it too wet invites problems. A good practice is to let the media dry slightly in between watering as this breaks the disease cycle. Maintaining an optimum EC and pH level promotes healthy, stress-free plants that are much less susceptible to crown rot.

Pythium irregulare

In the production of Osteospermum, *Pythium* will often attack a plant with a compromised root system, (stressed either from high salts or excess moisture). It starts by attacking juvenile tissues such as the root tip. After gaining entrance to the root the fungus may cause a rapid, black rot of the entire primary root and may even move up into the stem tissue. As the soil dries, new roots may be produced and the plant may recover or never show symptoms of disease.

Pythium infection

The pathogens that are responsible for *Pythium* root rot, also known as water mold, are present in practically all cultivated soils and attack plant roots under wet conditions. These fungi can be spread by fungus gnats and shore flies. Soil moisture conditions of 70% or higher are conducive to infection by *Pythium*. Good sanitation and moisture management are the first line of defense against this water mold.

Being a water mold, *Pythium* is controlled by different chemicals than *Rhizoctonia*. Chemicals with the active ingredient etridiazole (Truban, Terrazole/Banrot) are highly effective against *Pythium irregulare. Pythium* is not always impacted by the chemical methoxyacetyl (SubdueMAXX) so always rotate it with products that have a different mode of action. Biological controls for *Pythium* are forthcoming and offer possible alternatives to chemicals.

Insects

When producing Osteospermum at lower temperatures, insects are almost non- existent. However, when the temperature is increased for forcing growers need to monitor for aphids, caterpillars, spider mites, thrips and whiteflies. Some of the information below is gleaned from Raymond Cloyd's article on insects that appears in the Sakata Gerbera Manual.

Aphids

Aphids are soft bodied insects (2-3 mm) with antennae that use their sucking to feed on plant sap. The species most commonly found in greenhouse crops are the green peach aphid (Myzus persicae) the cotton or melon aphid (Aphis gossypii) the potato aphid (Macrosiphum euphorbiae) and the foxglove aphid (Aulacorthum solani). They usually are found in colonies on the undersides of tender terminal growth. Heavily-infested leaves can wilt or turn yellow because of excessive sap removal. Saliva injected into plants by these aphids may cause leaves to pucker or to become severely distorted, even if only a few aphids are present. Also, aphid feeding on flower buds and fruit can cause malformed flowers. In addition to aesthetic damage, Aphids are important vectors of plant viruses.

Infestations generally result from small numbers of winged aphids that fly in through open vents to suitable host plants. They deposit several wingless young on the most tender tissue before moving on to find a new plant. The immature aphids or nymphs that are left behind are all female and feed on plant sap and gradually increase in size. They in turn give birth to live young, which in turn can reproduce within 7-10 days. Individual aphids can give birth to 60-100 young (depending on host plants and nutritional status) over a 20-day period. Aphid numbers can rapidly build up to very large populations. The process is repeated several times, resulting in tremendous population explosions. Less than a dozen aphid "colonizers" can produce hundreds to thousands of aphids on a plant in a few weeks. Aphid numbers can build until conditions are so crowded, or the plant is so stressed, that winged forms are produced. These winged forms fly off in search of new hosts and the cycle is repeated.

Early detection is important as aphids multiply quickly. Scout for insects and the white flakes of skins that are cast off from molting insects. Control measures include both contact and systemic pesticides. Contact options include fatty acid salts and or insecticidal soaps, which disrupt the insect's cell membrane, and nervous system insecticides. Both of these require direct contact with the insects which can be challenging as aphids congregate on the lower leaf surface.

Systemic chemicals, such as Marathon, (Imidacloprid,1-) can be useful if there is sufficient time between the start of an infestation and the sell date of the crop. Since aphids are sucking insects, the systemic poison is easily taken in by the insects without having to be concerned about making direct contact.

Due to the ability of aphids to rapidly reproduce, the use of biological controls is not practical unless implemented as a long term strategy prior to filling the greenhouse with crops. However, good cultural practices, such as watering and fertilization, will help to reduce stress by these insects. Problems with honeydew and sooty mold may develop but tend to be temporary and disappear after the aphids are gone.

Caterpillars

Caterpillars are the larval/immature stage of moths and butterflies and are mostly a problem from late spring through early fall. Plants produced outdoors or those grown in open structures are vulnerable to attack. Butterflies and moths lay eggs which hatch into caterpillars with chewing mouthparts causing damage to Osteospermum leaves and flowers. If left unchecked, major damage can occur.

The lifecycle takes approximately 3-4 weeks and consists of an egg, caterpillar or larva, pupa and adult. Adult female moths lay anywhere between 20-100 eggs during their lifetime. Eggs hatch into caterpillars that consume plant foliage and flowers. Caterpillars live 7-10 days and gradually increase in size feeding voraciously at first, then less as they prepare for pupation.

Fecal deposits on plant leaves or leaf rolling are good indicators of caterpillar activity. Yellow sticky cards will also capture adults and aid in timing pesticide applications. Plants should be monitored on a regular basis; especially those located near doors and side vents. Reducing night lighting, which attracts adult moths, along with good weed control and sanitation reduces populations.

Pest control materials are directed primarily at the caterpillar stage. Most of these materials have contact activity only, so thorough coverage of all plant parts is essential. Systemic insecticides are generally not effective in controlling caterpillars. The microbial insecticide Dipel (Bacillus thuringiensis var. kurstaki) is effective but must be

applied when caterpillars are young as the active ingredient has to be consumed to be effective. Re-application of Dipel is often needed; especially when used outdoors due to rainfall and UV light which breaks down the chemical.

Biological controls with parasitic wasps in the genus Trichogramma attack the egg stage of various caterpillar species, including diamondback moth, cabbage looper and imported cabbageworm. The life span of the parasitoids is approximately seven days as it matures within the egg, and then up to 10 days as adults. Several species of Trichogramma wasps, including T. minutum and T. pretiosum, are available from commercial insectaries. For more information, consult a biological control supplier.

Twospotted Spider Mite

Twospotted spider mite is approximately 1.6-mm long, and oval shaped. They vary in color from greenish yellow to reddish orange. The adult females possess distinct black spots located on both sides of the body. Adult females live about 30 days and can lay up to 200 small, spherical, transparent eggs on leaf undersides. The life cycle from egg to adult takes 1 to 2 weeks, depending on temperature. For example, the life cycle from egg to adult takes 14 days at 70°F/21°C and seven days at 90°F/29°C.

Management generally involves combining cultural practices with the use of miticides. Cultural practices that may be helpful in controlling populations are listed below.

1) Avoid over fertilizing Osteospermum; especially with ammonium, as this results in the production of soft, succulent tissue that is easier for twospotted spider mite to penetrate with their mouthparts.

2) Remove “old” plant material, which may serve as an inoculum source for mites for subsequent crops.

3) Avoid over stressing the plants with water (too dry) because this increases susceptibility to attack.

4) Remove weeds from within and around greenhouses because weeds (including the nightshades and creeping woodsorrel) are hosts for twospotted spider mite.

If insecticides are needed, thorough coverage of all plant parts, especially the underside of leaves, is essential. Products with translaminar activity, that enable the chemical (after foliar application) to move from the top of the leaf surface to the bottom, work well. Insecticidal soaps may be phytotoxic, so read the label to determine on which mite life stages each material works best.

It is extremely important to rotate miticides or insecticide/miticides with different modes of action in order to reduce the possibility of mite populations developing resistance. Greenhouse producers should only use a material once or twice during a generation (depending on the time of year) then switch to another material with a different mode of action.

Western Flower Thrips (WFT)

Western flower thrips (*Frankliniella occidentalis*) feeding on Osteospermum flowers and leaves results in leaf scarring, necrotic spotting, distorted growth, and sunken tissues (primarily on leaf undersides). Damage to flowers or un-opened buds may result in flower bud abortion or deformation of flowers.

Western flower thrips are slender, small insects approximately 2.0 mm in length with fringed or hairy wings. They may vary in color from yellow-brown to dark brown. Adult females insert eggs into leaves. They can lay up to 250 eggs during their 45 day lifespan. Eggs hatch into nymphs that feed on leaves and flowers. Western flower thrips will pupate in flowers, leaf litter, or growing media. Adults that emerge from the pupae stage typically feed on flowers. The life cycle, from egg to adult, takes approximately three weeks to complete although this is dependent on temperature.

Sanitation practices such as removing weeds, old plant material debris, and growing medium debris will minimize problems with WFT. Remove plant material debris from the greenhouse or place into containers with tight-sealing

lids. Screening greenhouse openings such as vents and sidewalls will prevent WFT from entering greenhouses from outside. The appropriate screen size or mesh for WFT is 192 microns (132-mesh).

The principal management strategy is to apply insecticides when populations are “low,” which avoids dealing with different age structures or life stages—eggs, nymphs, pupae, and adults—simultaneously over an extended time period. Contact insecticides or those with translaminar activity are generally used to control WFT, because systemic insecticides typically don’t move within flower parts (petals and sepals) where WFT adults normally feed. Treating early, prior to insects entering the terminal or flower buds, is critical as treating open flowers is risky and may lead to damage. High-volume sprays are typically used to kill WFT that are located in hidden areas of plants such as un-opened flower buds.

Three to five applications within a 7 to 10 day period may be needed when WFT populations are “high” and there are different life stages present or overlapping generations. Frequency of application depends on the time of year (season), as during cooler temperatures the life cycle is extended compared to warmer temperatures, which will influence the number of applications required.

The primary way to prevent or minimize the potential of WFT populations from developing resistance and prolong the effectiveness of currently-available insecticides is to rotate insecticides with different modes of action. In general, rotate different modes of action every two to three weeks or within a generation. However, this depends on the time of year since the development rate of the life cycle is temperature dependent.

Biological control of WFT relies on using natural enemies such as predatory mites (*Neoseiulus* or *Amblyseius* spp), minute pirate bugs (*Orius* spp.), and entomopathogenic fungi (*Beauveria bassiana*). However, the key to implementing a successful biological control program against WFT is to release natural enemies early enough in the cropping cycle. Releases must be initiated prior to WFT entering terminal or flower buds. Natural enemies will not control an already established or existing “high” WFT population, because it takes time from initial release before natural enemies will lower WFT numbers below damaging levels.

Whiteflies

The major whitefly species include the greenhouse whitefly (Trialeurodes vaporariorum) and silverleaf whitefly (Bemisia argentifolii), which is synonymous with the sweet potato whitefly (Bemisia tabaci) B-biotype. Most whitefly life stages (eggs, nymphs, pupae, and adults) are located on the underside of leaves. The nymphs cause direct plant injury by feeding on plant fluids, which results in leaf yellowing, leaf distortion (curling), and plant stunting and wilting. The nymphs also produce a clear, sticky liquid material called honeydew that serves as a growing medium for black sooty mold fungi. The presence of large numbers of whitefly adults can be a visual nuisance, which may impact salability of an Osteospermum crop.

Adult whiteflies are white, narrow-shaped, and about 2.0 to 3.0 mm in length. Adult females deposit eggs in a crescent-shaped pattern on leaf undersides. Eggs hatch into nymphs or crawlers that migrate short distances then settle down to feed within the vascular plant tissues. The life cycle, from egg to adult, takes approximately 35 days; however, this is dependent on ambient air temperatures. A single female whitefly can lay eggs 1 to 3 days after emerging as an adult. Each female may live for about 30 days and lay up to 200 eggs.

Whitefly control involves implementing cultural, insecticidal, and biological control strategies; preferably using all three. Whiteflies are attracted to plants receiving abundant levels of nitrogen-based fertilizers. Sanitation is always the most important means of avoiding and reducing problems with whiteflies. Weed removal (inside and out) eliminates potential sources of whiteflies since certain weeds such as sow thistle (Sonchus spp.) and creeping woodsorrel (Oxalis corniculata) may harbor whitefly populations.

Whiteflies are vulnerable to contact, translaminar, and systemic insecticides. Contact insecticides, including many insect growth regulators, insecticidal soaps, horticultural oils, pyrethroid-based insecticides, and other insecticides with contact activity are effective against whiteflies; however, more than one application may be needed because these insecticides are primarily active on two life stages: nymphs and adults. In fact, insect growth regulators only kill whitefly nymphs with no direct activity on the adults. In addition, contact insecticides are primarily effective early in the crop production cycle since the smaller plant size makes it easier for sprays to penetrate the crop canopy and

ensure adequate coverage of leaf undersides. Systemics such as the neonicotinoid-based insecticides and feeding inhibitors are also effective against whiteflies, especially when applied early on in the crop cycle and before whiteflies build-up excessively. Systemic insecticides may be applied as a drench to the growing medium or to the foliage. There are a number of insecticides that have both translaminar and systemic properties.

Biological control is another strategy that may be successful in dealing with whiteflies on SuperCal. This involves using either parasitoids, predators, or beneficial (=entomopathogenic) fungi. Biological control agents (=natural enemies) commercially available include the parasitoids, Encarsia formosa, Eretmocerus eremicus, and Eretmocerus mundus; the predatory ladybird beetle, Delphastus catalinae; and the beneficial fungus, Beauveria bassiana (sold as BotaniGard and Naturalis-O).

Attribute List

Series	Average Flower Size	Habit	Height x Width
Side Show		Upright	12 x 14 in. / 30 x 35 cm.
Cape Daisy		Upright	14 x 16 in. / 35 x 40 cm.
Cascadia Daisy		Trailing	8 x 16 in, / 20 x 40 cm.
Crescendo*		Upright	12 x 14 in. / 30 x 35 cm.

*Crescendo Primrose and Yellow are extra vigorous and grow 16 x 16 in. / 40 x 40 cm.

Crop Schedule

Osteospermum is not photoperiodic but growth and development is accelerated under long day conditions and higher light levels. Also, once vernalized warmer temperatures reduce time to flower. The chart below summarizes these factors.

Factors that influence plant development and flowering

Factor	Effect
Day length < 12 hours	Increases crop time
Day length > 14 hours	Decreases crop time
***Temperature < 60°F/21°C**	Increases crop time
***Temperature > 60°F/21°C**	Decreases crop time
Light Level < 5,000 f.c./ 54,000 lux	Increases crop time
Light Level > 5,000 f.c./ 54,000 lux	Decreases crop time

*after vernalization and flower buds are set

Side Show Series *(Osteospermum hybrida) schedule*

Container Size	Weeks to establish in the pot	Weeks from pinch to cooling*	Weeks - flower induction 55-65 / 13-18C	Weeks - bud development 60-65F/16-17C	Total Corp Time in weeks (unrooted**)
4 inch / 10 cm.	1	1	2-3	7-8	14-16
6 inch / 15 cm.	1-2	1-2	2-3	7-8	14-18
8 inch / 20 cm.	1-2	1-2	2-3	8	15-18
10 inch / 25 cm.	2	2	2-3	8	17-18

*Pinch after establishing with roots ringing the bottom of the pot.

**assumes 3 weeks rooting time

Cape Daisy Series *(Osteospermum hybrida) schedule*

Container Size	Weeks to establish in the pot	Weeks from pinch to cooling*	Weeks – flower induction 40-50F /4-10C	Weeks – bud development 55-60F /13-16C	Total Corp Time in weeks (unrooted**)
5 inch / 12 cm.	1	1	2-3	7-8	14-16
6 inch / 15 cm.	1-2	1-2	2-3	7-8	14-18
8 inch / 20 cm.	1-2	1-2	2-3	8-9	15-19
10 inch / 25 cm.	2	1-2	3	8-9	17-19
Patio Trees	8-10	2	3	7-9	23-27

*Pinch after establishing with roots ringing the bottom of the pot

**assumes 3 weeks rooting time

Cascadia Daisy Series *(Osteospermum hybrida) schedule*

Container Size	Weeks to establish in the pot	Weeks from pinch to cooling*	Weeks – flower induction 40-50F /4-10C	Weeks – bud development 55-60F /13-16C	Total Corp Time in weeks (unrooted**)
6 inch / 15 cm.	1-2	1-2	3	7-8	15-18
8 inch / 20 cm.	1-2	1-2	3	8-9	16-19
10 inch / 25 cm.	2	2-3	3	8-9	18-20

*Pinch after establishing with roots ringing the bottom of the pot

**assumes 3 weeks rooting time

Crescendo Series *(Osteospermum hybrida) schedule*

Container Size	Weeks to establish in the pot	Weeks from pinch to cooling*	Weeks – flower induction 55-65F /13-18C	Weeks – bud development 60-65F/16-17C	Total Corp Time in weeks (unrooted**)
6 inch / 15 cm.	1-2	1-2	5-6	3	13-16
8 inch / 20 cm.	2-3	2-3	5-6	3-4	15-19

10 inch / 25 cm.	2-3	2-3	5-6	3-4	15-19

*Pinch after establishing with roots ringing the bottom of the pot

**assumes 3 weeks rooting time

Balancing temperature influence on crop time and flower power.

Cooler temperatures reduce daily fuel consumption, but increase crop time. However, cooler temperatures increase flowers and buds per plant. Although Side Show and Crescendo set flowers at higher temperatures, growing cooler naturally controls height and increases flower power. The following charts illustrate these points.

Number of weeks from pinch to 3 open flowers					
	48°F/9°C	54°F/12°C	60°F/16°C	66°F/19°C	72°F/22°C
Side Show Series*	12½ - 14	10 - 11	8½ - 9½	7 - 8	7 – 8
Crescendo Series	11½ - 13	9 - 10	8 – 9	7 – 8	7 - 8

*based on Bicolor Purple and Purple only

Number of flowers and buds per plant					
	48°F/9°C	54°F/12°C	60°F/16°C	66°F/19°C	72°F/22°C
Side Show Series*	48	38	29	24	24
Crescendo Series	40	28	22	21	16

*based on Bicolor Purple and Purple only

Customer Care

Top dressing with a slow release fertilizer works well to keep the plants healthy and full of flowers. In areas with high alkaline water, periodic applications with an acid fertilizer, such as Miracle-Gro, is recommended to avoid iron deficiency.