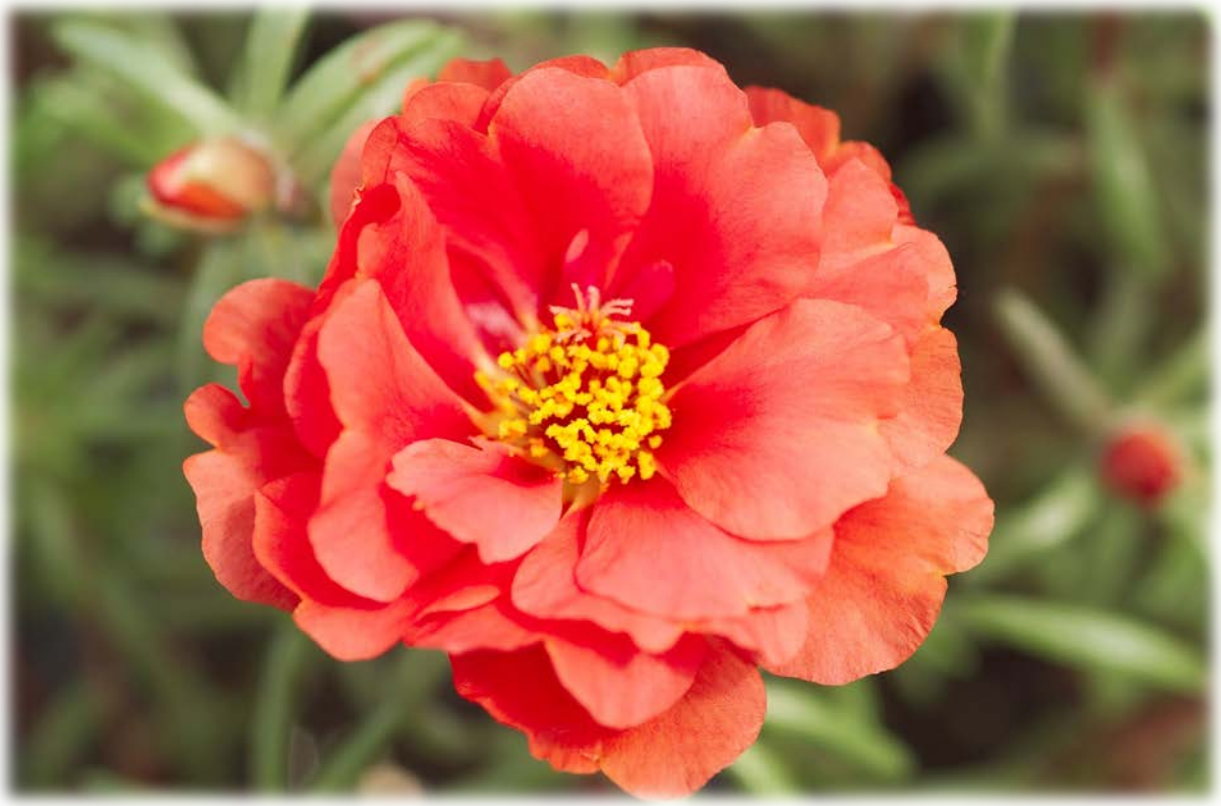
Portulaca

CULTURE GUIDE



SAKATA®

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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, rockwool and media blends with coarse peat and 30-40% aggregate are all good choices. Avoid using media with fine peat and vermiculite that hold excessive moisture. Target the media pH between 5.5 and 6.5 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 are best stuck immediately and should not be held as they break down easily. If absolutely necessary, store in a cool, shady area or refrigerator at 50°F/10°C. If leaving overnight, open the box and allow the cuttings breathe and prevent moisture build up. Do not expose the cuttings to temperatures below 50°F/10°C, or higher than 60°F/16°C.

Portulaca cutting, ready for sticking

Stage One: sticking to root emergence (Days 1-6)

Cell Size – 1¼ inch / 30 mm

Stick cuttings into a pre-moistened rooting medium. Portulaca roots easily without needing a rooting hormone.

Maintaining a slightly higher media temperature (+ 5°F/3°C) than the ambient air will encourage root development faster than shoot growth. Therefore, bottom heat is highly recommended for optimum results. Portulaca roots best at a media temperature between 70-75°F/21-24°C. Optimum light level for propagating Portulaca is 2,000 foot candles/ 22,000 lux.

In general, misting is not needed to root Portulaca, as it often promotes disease and rotting. However, in areas of high heat some minimal misting for 3-4 days might prove beneficial to keep the media moist. Portulaca does not produce a callus prior to root emergence as the stem tissue is soft and able to imbibe water.

Note: Unrooted cuttings may defoliate during shipment. Stem sections will easily regenerate with new leaves, but rooting speed will be delayed approximately one week.

Stage 2: root emergence (Days 7-13)

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. If grown with proper light, moisture and temperatures, chemical plant growth regulation is not required.

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.

Portulaca with root emergence

Stage 3: bulking (Days 14-20)

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 1.0 mmhos.

Pinching:

Liners may be pinched a week prior to transplanting to promote branching.

Note: Florel should not be used on Portulaca as it causes yellowing of foliage.

Portulaca showing strong root development

Stage 4: toning (Days 21-25)

Portulaca roots easily and should be ready for transplanting in 3-4 weeks depending on plug size. As the liners reach the transplant stage, allow them to dry down between watering to tone and prepare them for transplanting. Do not delay transplanting as Portulaca is a strong grower and plants will grow into each other making transplanting much more difficult.

Portulaca finished liner

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 Portulaca 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 Portulaca. 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.

Botrytis cinerea is a concern during propagation and primarily occurs from over watering, crowded plants and temperatures below 60°F /16°C. Extended cloudy conditions in winter create ideal conditions for this disease to occur. Botrytis is discussed in greater detail later in this guide under ***Disease.***

Insects - Propagation:

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. 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 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. Hand pulling or employing herbicides will kill existing weeds. Most importantly, eliminate the build-up of algae. Avoid excess watering and over fertilization of plants as this leads to 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.

Biological control is another option to manage fungus gnats when growing Portulaca. 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.

Transplanting

Media

Select a sterile media that is drains well with good aeration and a pH of 5.5 - 6.5. The media EC should be less than 0.75 mmhos (1:2 slurry).

Containers

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

Container Size	Number of Liners
4 inch/10 cm.	1
6-8 inch/15-20 cm.	3-4
Color Bowls	3-6
10 inch/40 cm.	5-6

Temperature

Establish the crop at an average daily temperature of 65°F/18° C. Once established, grow at 70°F/21°C average day and 60°F/15°C average night temperature. Provide good air circulation and a relative humidity below 70% to prevent Botrytis (gray mold).

Pinching

The first pinch may be done in propagation. If not pinched in propagation, make a soft pinch 2-3 weeks after transplanting when the roots are established and actively growing. Trim plants periodically as needed to shape.

Note: Insufficient fertilizer in the early stages reduces branching.

Light Level

Bright light is ideal for this crop. Provide a minimum of 5,000 foot candles/53,000 lux. Portulaca 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 keep the media too wet or too dry for extended periods. An overly wet media invites root disease (Pythium) and plant collapse. Whereas, allowing the plants to dry excessively in between watering leads to leaf necrosis.

Fertilizer

Commence fertilizing 2 weeks after transplant with a complete, balanced fertilizer at 250 ppm Nitrogen (constant liquid feed). Maintain the media pH at 5.5-6.5 and target the EC level at 2.5 mmhos (1:2 slurry). A slow release fertilizer is an option; especially for outdoor production where heavy summer rains are common. In addition, a slow release may provide improved performance for the consumer. Provide periodic clear water applications if excess soluble salts accumulate.

Cal/Mag formulations such as 13-2-13, 15-5-15 and 17-5-17 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.

Growing Tip: Avoid applying high amounts of ammonium under low light levels (<3,500 foot candles/37,000 lux) as it promotes excess vegetative growth at the expense of flowers.

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

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 fertilizer. 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 Portulaca 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 Portulaca, 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.	5-6 inch/12-15 cm. on center
6 inch/15 cm. or 1 gallon/4 liter	14 inch/35 cm. on center
8 inch/20 cm.	18 inch/45 cm. on center

Plant Growth Regulation

Chemical plant growth regulators should not be necessary if properly spaced and grown with adequate light levels. Optimum nutrition and pinching also contribute to well-branched plants.

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
Fertilizer	Maintain optimum EC level to optimize branching
Spacing on time	See chart under spacing

Disease

Portulaca 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 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.

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.

Root rot

Pythium irregulare

In the production of Portulaca*, 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.

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

Portulaca has thick fleshy leaves that resist insect attack. However, being a low growing ground cover they are susceptible to being attached by slugs/snails. Aphids, thrips and whiteflies may also be a problem. 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, aphids 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.

Mollusks

Slugs are usually not an issue for plants grown on benches in the greenhouse. However, slugs can be a serious problem in moisture laden areas where plants are set outdoors on ground beds. A single slug can turn a perfect plant into Swiss cheese overnight leaving behind a slime trail which serves as a road map for themselves and every other slug to follow. Slugs are hermaphrodites meaning that they have both male and female reproductive systems and produce two to three dozen ravenous offspring several times a year.

The egg clusters look like little piles of whitish jelly filled 4 mm balls (the size of a bb) and are hatched from 10 days to three weeks. These sluglings are born with a ravenous appetite and eat so much that they can mature from egg to adulthood in as little as six weeks. In turn these offspring start their own families.

To control slugs eliminate weeds where slugs hide, sleep and reproduce. Keep all decaying matter cleaned out of the growing area. Setting plants on coarse gravel or cedar bark irritates and dehydrates them. Baits that contain metaldehyde* are commonly used to control populations. An organic alternative are baits containing iron phosphate which is non-toxic to pets and wildlife.

Note: Be cautious using baits containing metaldehyde in areas where children and domestic pets are free to roam as it can cause accidental poisoning.

Western Flower Thrips (WFT)

Western flower thrips (*Frankliniella occidentalis*) feeding on Portulaca 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 a Portulaca 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 Portulaca. 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).

Variety Attributes

Series	Flower Size	Height x Width
Duet	1.5 inches / 4 cm.	6 x 12 inches / 15 x 30 cm.
Dynamite	1 inch / 2.5 cm.	6 x 12 inches / 15 x 30 cm.
Summer Joy	2 inches / 5 cm.	6 x 12 inches / 15 x 30 cm.
Sun Dance	1.5 inches / 4 cm.	8 x 18 inches / 20 x 45cm.

Crop Schedule

Portulaca is not photoperiodic but growth and development is accelerated under long day conditions and higher light levels. Also, 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 < 70°F/21°C	Increases crop time
Temperature > 70°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

Container Size	Rooting time	From Transplant	Total Crop Time
4 inch / 10 cm.	3-4 weeks	5-6 weeks	10-12 weeks
6 inch / 15 cm.	3-4 weeks	6-7 weeks	11-12 weeks
10 inch / 25 cm.	3-4 weeks	7-8 weeks	12-13 weeks
12 inch / 30 cm.	3-4 weeks	8-9 weeks	13-14 weeks

Customer Care

Portulaca is drought tolerant and requires minimal care. It is best planted in open, porous soil with good drainage. Overly wet soil conditions result in root diseases. Due to its drought tolerance, Portulaca is ideal for gardeners that travel or escape to weekend cottages. Top dress with a slow release fertilizer and apply a liquid fertilizer every two weeks 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 or Miracid, is recommended to avoid iron deficiency.

For Summer Joy, Duet and Dynamite space 9 inches/23 cm. apart in the garden. 16 plants will cover a square yard/square meter. For Sun Dance space 14 inches/35 cm. apart and 8 plants per square yard/square meter.

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