



Integrated Pest Management of Cannas for Production in Controlled Environments

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- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education

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- It utilizes research from university, government, and other sources to help people make their own decisions.
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- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
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- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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Canna lilies are a popular perennial grown from rhizomes (underground stems) and produce vibrant flowers and colorful foliage that can enhance the garden's decorative appearance. There are more than 30 species of cannas, with most commercial varieties as hybrids made by crossing two species. *Canna edulis* is one species that is commercially cultivated and is known as Queensland arrowroot. *Canna edulis* is common in Australia and the Caribbean. *Canna indica* is common in South East Asia and Africa. *Canna glauca* and *Canna gigantea* are native to Brazil. *Canna speciosa* is cultivated in Sierra Leone and is used as seasoning similar to turmeric. Hybrid cannas are used in gardens and landscapes and can

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be grown throughout the US. Cannas vary in size, flower and foliar colors (Table 1). It is typical for nurseries to sell bagged rhizomes to homeowners to plant in their gardens. Often, garden sellers and catalogues will list them as 'tubers' or 'bulbs,' which are terms most consumers can relate to, but are not technically correct. Sellers will market rhizomes by offering three to five eyes per rhizome. Rhizomes are generally packaged in damp peat or compost for sale to avoid drying out.

Garden centers and nurseries often sell potted plants in the spring to homeowners or landscapers who want the immediate benefit of colorful foliage and brilliant blooms in the spring and summer. Plants may be started by planting rhizomes in 12 inch pots in February or March, so the young plants are ready for transfer to the garden soil and will produce lush foliage and flowers in the spring and summer. The best commercial soil mixes for growing cannas are pH 6.5 and include sphagnum peat moss, perlite and dolomitic limestone. The dolomitic limestone contains calcium that reduces the toxicity of elements and the effects of acidic soils. Calcium

Table 1. Some examples of commercially grown Cannas available in the USA which perform well in containers.

Variety	Height ^a	Flower Color	Foliage	Additional Comments
Australia	Tall	Salmon	Burgundy	Best tall dark leaf canna available.
Black Knight	Tall	Crimson	Burgundy	Synonym is 'Black Velvet' because of deep leaf color.
Cleopatra	Tall	Yellow with Red Spots	Green with a broad burgundy stripe on each leaf.	The unusual leaf color combination is technically known as a chimera.
Red Futurity	Small	Crimson	Burgundy	Performs well in hot summers
Yellow Futurity	Small	Yellow with Red Spots	Green	Performs well in hot summers.
Kreta	Small	Orange and Red	Green	
Orange Punch	Medium	Orange and Yellow	Green	Flowers are named for the canned orange drink.
President	Medium	Scarlet Red with Yellow edges	Green	
Pretoria	Medium	Scarlet Red with Yellow edges	Variiegated	Synonym is 'Bengal Tiger'
Tropical Sunrise	Medium	Pink	Green	
Chesapeake	Medium	White	Green	

^a Tall (6 feet or more), medium (3 feet to 4 feet) and small (1 foot to 2 feet).

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is also an important nutrient for plants and is good for root growth and germination.

Starting cannas in a greenhouse can ensure the plants will be nurtured to achieve full size and produce lush beautiful foliage and blooms after they are transplanted.

For the nursery grower who wants to sell potted cannas to landscapers and home owners, disease is an important concern, which can jeopardize the marketability of the greenhouse produced cannas. There are reports from experts of an epidemic of canna virus and foliar rust spreading throughout the country and people are considering alternative bulbs for planting. Greenhouse nursery growers are justifiably concerned, because it is becoming harder to produce quality product for the home gardens. Many of the critical challenges to producing healthy cannas in the greenhouse can be reduced if managed appropriately, ensuring a clean, pest free plant. A discussion of the best practices for managing greenhouse cleanliness and sanitation, insects, viruses, as well as healthy fertilizing and watering habits is presented below.

Sanitation of the Greenhouse and Tools

The first thing is to ensure the greenhouse environment is properly sanitized. Starting with a clean environment can make or break your operation. Sanitizing floors, walls, windows, pots and benches should be the first thing anyone does to help rid the greenhouse of leftover plant debris, pollen and insects. Proper sanitation of benches, floors and pots can kill insects, fungi or viruses that might be lingering in the environment.

Disinfect floors, walls, windows, pots and benches with a solution of 1 percent Virkon® (diluted in water) by Dupont™. This can be carried out twice a month to effectively manage disease. Follow the label recommendation for preparing a 1 percent solution (mix 1.3 oz per gallon of water) and spray this on benches and floors. Virkon® is marketed for its ability to rapidly kill bacteria, fungi and viruses, and it has been determined to work very well in the greenhouse to reduce the incidence of fungus and viruses in a new canna crop. When Virkon® is not available, a solution of 20 percent bleach, which is another potent disinfectant, may be used for washing benches and floors; however Virkon® is preferred. A solution of 1 percent Virkon® or 20 percent bleach should be used to thoroughly wash the insides of all pots and tools. Read and follow label directions.

Integrated Pest Management

Spider mites, aphids, grasshoppers and caterpillars are the most frequently identified pests in greenhouse grown cannas. It is both the greenhouse environment and the lush canna leaves that attract these random pests. Spider mites can occur throughout the year, aphids are often seen in the early spring, while grasshoppers and caterpillars can be seen in late spring and early summer.

The two-spotted spider mite is a tiny moving yellow or bronze mite, which is related to spiders, and can produce webbing that covers leaves and flowers. Spider mites lay eggs on the underside of leaves. Spider mites are a major nuisance on cannas in the greenhouse and most often appear in the summer months. The nymphs and adults produce webbing, which can damage flowers and make leaves unattractive. Severe infestations can cause severe discoloration of canna leaves and stunt plant growth. Leaves will look silvery and can

become dried and scorched when infested. The damage can be so severe, some might think that the scorched leaves are caused by a fungus or virus. There are natural enemies, but it is very important to consider which ones to introduce into the greenhouse. For example, western flower thrips, *Frankliniella occidentalis*, is a predator that feeds on the mite eggs, but thrips are also known to transmit plant viruses, so this is not an advisable predator to introduce into the greenhouse. A better choice might be the western predatory mite, *Galendromus occidentalis*, or minute pirate bugs (*Orius* spp.), which do not transmit plant viruses. Minute pirate bugs feed on eggs of a range of insects including aphids and caterpillars. These are all commercially available online.

The greenhouse can attract a range of caterpillars and moths. Caterpillars are the larvae that produce moths. Moths might be attracted by the greenhouse lights in the evening and can sometimes enter the greenhouse. They are a problem throughout the year. They can lay eggs in the soil or on the leaves and produce caterpillars that feed on the canna leaves. A range of caterpillars occur in the greenhouse, with no one species seeming to be a specific problem on canna. This is different from garden or field grown cannas. In outdoor environments, the larger canna leaf roller (*Calpodes ethlius*) and the lesser canna leaf roller (*Geshna cannalis*) can seriously devastate cannas. Corn earworm and woolly bear caterpillars are also reported to feed on garden cannas. Whichever the environment, caterpillars can leave huge holes in the leaves and ruin the aesthetics of the plant. Organic control of caterpillars can be simple hand picking to remove them from the leaves. Otherwise, natural predators could be used such as ladybugs and lacewings, which feed on the eggs.



Figure 1. Two spotted spider mite on canna leaf. There are an abundance of white eggs and the leaf looks silvery from spider mite damage.

Table 2. Biological and Chemical Control Methods for Cannas Grown in Greenhouses.

<i>Pest and Disease</i>	<i>Natural Enemy</i>	<i>Chemical Control</i>
Spotted spider mites	Western predatory mite Minute pirate bugs	Neem oil, <i>Beauveria bassiana</i>
Bird cherry oat aphids	Lady bugs, Minute pirate bugs <i>Aphidoletes</i> parasitic wasp	Carbamyl (1-naphtyl methylcarbamate)
Caterpillars	Lady bugs, lacewings Minute pirate bugs	Carbamyl (1-naphtyl methylcarbamate)
Canna Rust		Copper fungicides
Canna Viruses		Virkon®, Bleach



Figure 2. Bird cherry oat aphid identified in greenhouse on canna leaves.

Bird cherry oat aphids have been identified in stored rhizomes and in the foliage of potted plants. Although these aphids are most commonly found on cereals, they seem to have a presence in greenhouse grown cannas. They appear in the cooler months in the early spring. At the time of publication, it has not been determined their feeding habits cause damage to the leaves, but they do pose a threat requiring a viable management strategy. There are a number of natural enemies to aphids including parasitic wasps, *Aphidoletes*, and lady beetles that can be quite effective for controlling aphid populations in the greenhouse. These can be purchased online from a number of merchants.

In addition to insect and mite pests, canna rust sometimes appears in the greenhouse in the spring. Canna rust is caused

by *Puccinia thaliae*. Symptoms include yellow spore-producing structures on the lower side of the leaf and tan spots on the upper side of the leaf. The best practice is to remove and discard leaves as soon as the rust appears.

Insect and mite pest populations and canna rust can be effectively reduced or eliminated by careful monitoring and implementing a reasonable integrated pest management plan. Such a plan includes, combining weekly treatments of Neem oil extract with organic pesticides that contain *Beauveria bassiana*. This combination can devastate spider mite colonies and protect canna foliage from damage by aphids and other insects. Neem oil extract (100 percent) is a miticide that can be used to treat canna foliage. Neem oil is a natural disinfectant and routine weekly treatments in the spring and fall can control spider mite infestations. Treat rhizomes with a pesticide that contains *Beauveria bassiana* before planting in the soil, then treat plants weekly with this organic pesticide once foliage has emerged. When caterpillars are a problem in the greenhouse, Carbaryl (1-naphthyl methylcarbamate) is effective for controlling both caterpillars as well as aphids. Each of these products can be obtained at any local retailer. Other important practices include keeping the grass mowed around the greenhouse and introducing biological control agents.

Control canna rust with fungicides applied in the first weeks following planting of rhizomes in fresh soil. For commercial greenhouses, liquid copper-based sprays are recommended to control canna rust. The use of plastic tank sprayer attachments ensure faster treatment of plants, accuracy in the amount of chemicals being used and that every plant is treated as thoroughly as needed. There are also a number of products greenhouse growers can recommend to customers that are effective in the home garden to preserve the beauty of cannas once they leave the greenhouse. Fertiome® liquid systemic Fungicide 2, Spectracide® 16-oz Multipurpose Fungicide Spray Concentrate for Gardens Liquid, and Daconil® 32-oz Fungicide Ready-to-Use Liquid are all effective for preventing fungal diseases in cannas. Many of these chemicals come in spray-bottle form; these are great for smaller gardens and greenhouses.

Controlling and identifying virus disease in canna is much more difficult. Sanitation practices provide the best means to prepare the area for planting, as well as destroy viruses that might be in the environment. If viruses are introduced later, it is much more difficult to manage. One recommendation is to

contact the Oklahoma State University Diagnostic Laboratory and send a sample for testing to identify whether the disease is due to a virus. Plants testing positive for a virus should be removed so the disease does not spread to other plants.

Given the number of recommendations for integrated pest management, watering and fertilizing, a greenhouse care chart can be used to ensure organized and routine care and maintenance of cannas. On the following page is a blank chart that can be attached to a clipboard and used to manage monthly care and maintenance of greenhouse grown cannas. This sheet allows for best communication among plant care specialists and can be used for small and medium size operations.

Below is a filled out Greenhouse Care Chart for one week and an empty sheet (following page) that can be used is attached at the end. Examples of the kinds of information that can be hand written into each column by the plant care specialist are the following:

- **Watering** is best carried out either using a hose for individual plant care, mainline tubing with drip emitters, or another type of multi-outlet drip assembly. It is important for smaller operations growing plants on greenhouse benches to ensure water gets under the leaves and into the soil. Drip stakes or overhead watering are not advisable for a greenhouse bench containing mixtures of dwarf, medium and tall plants, but may be preferred for other types of greenhouse operations. In the watering section, the terms "heavy" and "spot" were used as shorthand for what was carried out on those days when watering was done with a hose. When using a hose for watering individual plants on a bench, 'heavy water' in this case is used to explain that the pots were soaked until the water drains through the bottom holes in all plants on the bench. 'Spot watering' is carried out when the pots do not seem uniformly damp across the bench, applying water to drier plants.

When using a drip irrigation system, the water can be turned on at a source and left on for a period of time. It is important to use a gauge and record the water pressure along with the period of time spent watering.

- **Floors** should be sanitized using bleach or Virkon® biweekly to keep pests and diseases at bay.
- **Pruning** can mean three things: a) removing dead or diseased leaves detracting from the beauty of the plants, can be a source for spreading disease in the greenhouse or a source of debris on the bench; or b) for bulk expansion of rhizomes. Once the flowers are bloomed out, plants can be cut back to the ground and they will produce new shoots. This can also encourage rhizomes to expand, doubling or tripling in size; c) dead heading the stalk when the flower is bloomed out. This can encourage the plant to put out another bloom in a few days.
- **Fertilize** plants initially on the day they are planted and then every 30 days thereafter, if you use a liquid feed. Apply only once if using controlled release fertilizer. The fertilizer needs are calculated by oz/gallon, dilution ratio, or ppm for the injector system or hand watering. The commercial source of fertilizer can be recorded as well.
- **Pesticide and fungicides** should be used early in the morning before sunrise to avoid chemical burns to foliage. For cannas, pesticides and fungicides are more often delivered by spray applications using a liquid chemical carrier and a spray nozzle that targets the leaves and soil of growing plants. This should be done at least once per month. The amounts of pesticides can be provided as a ratio or PPM. Several different types of commercial sprayers are available for greenhouse operators. The choice of hydraulic high volume (HV) or low volume (LV) hand held or back pack sprayers depends upon the size of the plants and the needs of the greenhouse operation.

One may choose a delivery system for small emerging plants or full grown dwarf varieties, while another might be preferred for effective management of disease and pests on tall varieties.

- The point of keeping these **records** is to enable operations to compare equipment or pesticides from different sources and costs over the long term. Remember to properly date each section in order to keep a thorough record of when proper care is needed for future reference.
- The **location** section can refer to bench or greenhouse identifier.

If you think your plants are infected with virus, please contact Oklahoma State University Plant Diagnostic Services for

testing. More information about greenhouse pest management including a list of common pests and pesticides can be found in Oklahoma Cooperative Extension Service publications:

- CR-6718 Current Report: Management of Insects and Mites in Greenhouse Floral Crops
- HLA-6707 Pesticide Use and Safety in the Nursery and Greenhouse
- HLA-6710 Integrated Pest Management in Commercial Greenhouses: An Overview of Principles and Practices.
- E-917 Propagation of Ornamental Plants for Oklahoma

Table 3. Greenhouse Care Chart.

<i>Date</i>	<i>Watering</i>	<i>Clean floor</i>	<i>Pruning</i>	<i>Fertilizer Application</i>	<i>Pesticide Application</i>	<i>Fungicide Application</i>	<i>Date</i>	<i>Location</i>
Monday	Heavy		Dead leaves					GH 1,2
Tuesday	Spot		Dead heading			Soil, leaves		GH 3,4
Wednesday		Virkon® or Bleach			Leaves, flowers			GH 1,2
Thursday			cut back to soil		Spot application,			GH 3,4
Friday	20 min drip xx psi water pressure			Oz/gallon or ppm	HV or LV sprayer	Soil, leaves, application equipment used		
Saturday								
Sunday								

* Be sure to note concentration and volume where applicable.

Greenhouse Care Chart

Name: _____ Greenhouse Bench No: _____

<i>Date</i>	<i>Watering</i>	<i>Clean floor</i>	<i>Pruning</i>	<i>Fertilizer Application</i>	<i>Pesticide Application</i>	<i>Fungicide Application</i>	<i>Date</i>	<i>Location</i>
Monday								
Tuesday								
Wednesday								
Thursday								
Friday								
Saturday								
Sunday								