



Greenhouse Propagation of Ornamental Cannas Grown from Rhizomes or Seeds

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The garden canna lily typically is a hybrid variety produced by breeders crossing two or more species, producing plants with lush tropical foliage and large showy flowers. The flowers are usually red, orange, yellow or combinations of these colors. The leaves are broad, like banana trees, and are solid green, bronze, deep burgundy or green leaves, variegated with white, yellow or red. Often, retail greenhouses sell young, leafy plants to consumers considering the best landscape arrangements.

Retail greenhouses rely on wholesalers to purchase seed or rhizomes. Retailers need to consider the best management practices that will produce pristine, tropical-looking plants consumers want to buy. In recent years, there have been diseases associated with cannas grown from rhizomes and breeders have been working to produce hybrid varieties that can be grown from seed. Wholesale canna rhizomes and seeds can be purchased from online catalogues and the nursery agent needs to be informed of key considerations when purchasing and growing cannas rhizomes and seeds. The greenhouse grower also needs to employ slightly different management practices for producing handsome young plants from rhizomes or seeds.

The websites in Table 1 report disease incidence and health of the cannas in their production system, so the consumer is informed of the disease risk they are facing when purchasing seeds or rhizomes.

Storing and Planting Canna Rhizomes and Seeds

The best-looking canna rhizomes for retail production are starchy white and should have two or three buds. It is important to keep rhizomes in cool moist storage if not planted immediately. For example, production greenhouses will likely purchase rhizomes from wholesalers in the autumn or winter months, then store them in moist peat or horticultural sand and at cool temperatures (50 F). Dormant rhizomes are fleshy and can be subject to rot if they are too moist in storage, or can dry out from too low humidity, which affects their ability to grow. Highly moist environments attract fungal gnats or fungal gnat larvae to rhizomes. Fungal gnats are short-lived flies that deposit larvae in plant roots and rhizomes. The larvae are known to transmit fungi causing rot. *Sclerotium rolfsii* and *Fusarium* spp. are reported to infect canna rhizomes (Kessler, 2007). Storing canna rhizomes or planting them in pots with a thin layer of horticulture sand is sometimes recommended to protect rhizomes from fungal gnats (Cloyd, 2010). If the rhizomes are healthy, and grown in a greenhouse with adequate water, foliage emerges fairly quickly. Dwarf varieties produce flowers within two months and taller varieties may take up to three months to produce flowers.

Table 1. Online Retailers for Cannas.

<i>Seeds</i>	<i>Rhizomes</i>
www.outsidepride.com	www.cannas.net
www.karcheskycanna.net	www.karcheskycanna.net
www.harrisseed.com	dutchbulbs.com
www.ebay.com	hollandbulbfarms.com
www.swallowtailgardenseeds.com	www.edenbrothers.com
www.parkseed.com	www.longfield-gardens.com/canna

Cannas grown from germinating seeds produce foliage slower than cannas grown from rhizomes. The brown or black seeds, commonly called “Indian shot” because they look like gunshot, measure 2 mm to 8 mm in diameter and have an extremely hard seed coat. The seed coat must be scarified using a nail clipper or knife to expose the white interior and help the embryo imbibe water. While seeds germinate well at room temperature, added warmth by placing germinating trays on heat mats, or transferring pots with seeds to the warmer temperature of the greenhouse are known to speed germination. The root and cotyledonary sheath are the first to appear at germination and the first leaves appear within two weeks of planting.

Flower Quality is Different Among Plants Grown from Rhizomes and Seeds

With regard to flower quality, hybrid plants grown from rhizomes typically produce uniformly colored, showy flowers with broad petals. However, hybrid plants grown from seed often favor one of the parental species and show more variation in flower morphology. For example, ‘President’ is a hybrid variety known for broad red flowers when grown from rhizomes (Figure 1). For comparison, seeds were planted that were identified as ‘President’ from an online retailer, and these plants produced inflorescences with several flowers from the base to the tip of the spike, but the petals were narrow. One drawback to growing cannas from seed is that these varieties often do not conform to the hybrid standards (Figure 1).

If the flowers look so different, why would wholesalers and retailers encourage consumers to purchase seeds rather than rhizomes? One reason is that many rhizomes are infected with viruses and plants grow up naturally infected. Also, rhizomes can be affected by insects and fungi, which require pesticides to manage. In contrast, seeds have such a hard coat that there is no chance for insects, fungi or viruses to penetrate the seed, so growers might consider seeds as a better alternative for producing healthy plants.



Figure 1. Flowers of the ‘President’ variety. The left image shows huge flowers when plants are grown from rhizomes. The image on the right shows smaller flowers.

Appropriate Greenhouse Environment Conditions for Producing Cannas

Whether growing plants from rhizomes or seeds, it is imperative care is taken to control insects and disease. Plants grown from rhizomes need more care than plants grown from seeds. Recommendations for greenhouse environmental controls, disinfection and pesticide controls to improve growth conditions for plants grown from rhizomes or seed are provided below.

Greenhouse temperature and lighting must be monitored for proper growth and flowering, with the greenhouse temperature is kept around 80 F. The heating and cooling set points are between 70 F and 75 F during the day. The nighttime cooling set point is 80 F and heating set point is 65 F. Sunlight can provide 13- to 16-kilo Lux (1.2 to 1.48 x 10³ foot candles) across the greenhouse. Lighting sensors detect when lighting diminishes below 13-kilo Lux and automatically turn on to maintain constant levels across the benches. The range of the sensor detect indoor high pressure sodium (red and yellow spectrum with typical luminous efficacy of 85 to 150 lm/W) and metal halide (blue and white spectrum with typical luminous efficacy of 75 to 100 lm/W). It is recommended to distribute lights every 5 feet to 6 feet to ensure consistent lighting across the canopy. Both the dark leaf and green leaf cannas grow well and produce flowers with these greenhouse lighting and temperature conditions.

Shade clothes might be required in July and August, when heat and sunlight levels inside the greenhouse might be difficult to control. Weekly assessments of light and temperature using a luminometer and thermometer are essential for deciding when to install a shade cloth. Greenhouses with a motorized apparatus that can extend or retract the shade clothes across the ceiling are ideal for reducing outdoor light and heat on particular days.

Greenhouse disinfection following a routine of pesticide treatments, along with fertilizer and water, are vital for success in a production greenhouse. Pests must be controlled from attacking the rhizomes and leaves. Virus-carrying aphids are known to lay eggs along the rhizomes, and rhizomes have been reported to test positive for virus infection. Often, plants appear to be naturally infected when the emerging leaves already show disease (Chauhan et al., 2015; Rajakaruna et al., 2014). While there are no scientific studies yet linking aphids to virus-infected rhizomes or leaves, as a precaution it is advisable to apply insecticides early. Canna leaves are susceptible to canna rust fungus, spider mite and aphid infestations. Table 2 provides a few products that are effective as part of a regime for greenhouse production of disease-free plants.

It is recommended to follow the routine below for preparing the space for planting and maintaining disease-free plants:

1. A 2 percent solution of Virkon S[®] Disinfectant, is a cost-effective disinfectant that kills viruses and bacteria. Four pounds during a one-year period for four cycles of disinfection of two 350-foot³ greenhouses is recommended. Spray benchtops and floors to disinfect the area before planting, using a hand-held sprayer on a hose to control the fluid concentration (use the 2-ounce setting). After disinfecting the greenhouse, it is best to let the room and materials dry completely before starting the process of planting seeds or rhizomes.

Table 2. Disinfectant and Pesticides for canna production.

<i>Treatments</i>	<i>Where to purchase</i>	<i>Application</i>	<i>Rotation</i>
Virkon S	Amazon, 10lb container	Dilution 1:200 30 liters per 100 m ² Application rate of 300 ml/m ²	Use on surfaces, applied using mechanical sprayer, prior to planting and after harvest
Admire Pro	Bayer Crop Science	0.1 fl oz/1,000 plants	Apply once in greenhouse at planting
Sonata Biofungicide	Bayer Crop Science	2 quarts/100 gallons	Apply at planting, and then every two weeks as needed to prevent rust infections

- Plant rhizomes in 2-gallon pots in LC-1 medium. Apply a granular fertilizer with a N:P:K ratio of 12:12:12, such as Dynagreen® All Purpose granular fertilizer. Then, plants are fed every 14 days, using liquid fertilizers with an N:P:K ratio of 24:4:8. It is recommended to load the liquid fertilizer into a container attached to a hose-end adapter and spray the contents over a 400-square-foot area, watering the soil until it is mildly saturated.
- A systemic insecticide such as a 2 percent solution of Admire Pro® (Bayer Crop Science), can be applied to the soil at planting time to reduce the damaging impacts of virus-transmitting insects, such as aphids. Such an insecticide is compatible with fluid fertilizers and can be mixed in a tank with water and applied along with the fertilizer by adding to the bottle attached hose.
- Biofungicides such as Sonata® Biofungicide (BayerCrop Science) are used to control rusts. Within three days of planting rhizomes in pots, a 2 percent solution of Sonata® biofungicide can be applied using a hand-held sprayer to prevent canna rust or soil mildews that can affect germination. Other biofungicides are described in <http://www.extension.org/pages/29382/>
- For growing seeds, the problems of soil-borne or rhizomes-born insects are eliminated. Early treatment with insecticide or biofungicide is not necessary to ensure germination.
- Horticultural oils, especially 70 percent neem oil, can be used to control spider mites that are highly attracted to canna leaves in greenhouses (Cranshaw and Baxendale, 2014).

Conclusion

Generally, hybrid plants that have the large beautiful flowers do not produce seeds, and the only way to produce these plants in the greenhouse or garden is by planting rhizomes. However, plants grown from rhizomes require care to reduce insects, fungus and viruses, which may occur in storage or in outdoor environments. It is recommended to use disinfectants and pesticides to reduce the possibility of disease in

the greenhouse throughout the growing season. Plants grown from seed require less treatment with fungicide or insecticide and are typically virus-free. However, their flowers are not the same as the hybrid varieties. While both may produce beautiful displays in the garden, the flowers that define the hybrid varieties are only seen when plants are grown from rhizomes.

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