

Erwinia

Zantedeschia Technical Bulletin C02/12

Erwinia carotovora sub spp. **carotovora**, bacterial soft-rot, is the most serious disease affecting Zantedeschia (Calla lily).

Erwinia is generally a secondary bacterial infection resulting in a total melt down of plant and tuber tissue. It is characterized by soft, decaying tissue; damp, disintegrating stems and a foul smell.



Plant affected by *erwinia*

Erwinia can also cause post-harvest *slimy stem* to cut flowers. One infected stem can ruin the life of all associated stems in the bunch or vase.

Plant stress combined with fungal pathogen attack (*pythium*, *rhizoctonia*) and poor crop hygiene is the main cause of secondary soft rot.

Controlling *erwinia* is largely a management issue - a strong healthy plant and good hygiene will significantly reduce the incidence of the disease.

Common causes of stress and subsequent *erwinia* soft rot attack include:

1. TEMPERATURE

Optimum soil/media temperature (root zone) for growing callas is 20°C. Soil temperatures above 25°C may result in stress, influx of primary fungal infection followed by secondary bacterial *erwinia*.

Although greenhouse air temperatures may rise above 30°C, plant canopy temperature should be maintained at a maximum of 25-28°C.

Solution

1) Plant tubers deeper in hot conditions to reduce root zone temperature. Measure soil temperature at surface level and then at tuber depth (5-10cm), as temperature differential can be up to 5°C.

In hot or equatorial conditions cover top of tuber by at least 10cm of media/mulch - **see #3**.

2) Ensure soil or media is free draining so that irrigation water passes through easily at all times during the growing cycle, helping to cool the growing bed and tuber-root zone.

3) Use mulch: untreated pine sawdust, rice husk or straw on top of the growing media to reduce temperature and help retain soil moisture (also reduces weeds).

4) Use shade cloth (30-50%) in high light conditions to reflect sun and reduce temperature. Movable shade can be used during the hottest part of the day (eg. 11am – 4pm) to reduce temperature; it can be removed in the cooler part of the day to maintain high light.

Paint greenhouses with chalk type white paint (e.g. **So-white**, **Redusol**) to reduce air temperature by up to 5°C. This may be washed off prior to tuber harvest to help dry soil and pre-cure tubers.

5) Maintain ventilation and horizontal air flow at all times, especially during high humidity. Open greenhouse every morning to introduce fresh air. Top vents and roll-up side vents are a big advantage for good airflow.

Using large volume air fans for improved horizontal air movement is highly recommended - operate 24 hours a day through the growing cycle.

Crop Hygiene

If *erwinia* occurs, all affected plant tissue and tuber/s should be immediately removed and disposed of.

Apply **Kocide®** (Copper hydroxide) to the affected area. Follow with a drench of **Ridomil®** within a few days to help prevent further fungal attack.

2. WATER & IRRIGATION

Clean, treated water has been proven to be one of the best defenses against fungal and bacterial attack in Zantedeschia. Addition of residual chlorine in irrigation water is very effective.

If plants collapse with *erwinia* the tendency is to withdraw irrigation. Dry conditions may however lead to more stress and losses, and as roots struggle to find enough moisture to keep up transpiration tissue damage occurs.

Further root loss creates greater moisture deficit, more stress and eventually total plant collapse. **Key is immediate removal of affected material.**

Solution

Callas require consistent watering throughout the growing cycle. Irrigation should be adjusted to meet demand especially when evapo-transpiration rates are high in hot temperatures/low humidity.

Monitor moisture levels daily. A tensiometer can assist however regular observation and manually checking soil moisture at root level is essential.

Reduce irrigation in cool, overcast or rainy weather. Too much water can lead to constantly water logged roots. Plants are then more prone to attack by primary fungal pathogens (eg. *pythium*).

Free draining soil or media is vital to ensure water and nutrient flows through the root zone during the total growing cycle to completion of tuber multiplication. Free drainage and raised beds are especially important if growing outdoors with no rain control.

Only reduce irrigation 3-4 weeks prior to completion of full growing cycle of 28-30 weeks.

Water Quality

Dirty or pathogen loaded irrigation water is a common cause of infection, especially when the plant is in stress.

River or open reservoir water is often badly infected especially after rain when surrounding catchment water contaminates the source and results in high levels of *pythium*.

Clean water is essential during the tissue culture transfer growing cycle, as increased *pythium* and water borne fungal pathogens can devastate a growing crop.

Filter source water and treat with chlorine (Calcium Hypochlorite), ozone, peroxide or other available redox reagent. This is a two part process – cleaning the source water and secondly the adding of a residual disinfectant (eg. Chlorine)



Tuber affected by *Erwinia*

Maintaining a residual of 1.5-2ppm of chlorine in the irrigation water (at discharge) has been found to be very effective. Allow turnover time in the water tank prior to use – direct injection is much less effective. Particular care with water quality and overall hygiene at flower harvest is essential to help avoid infection.

3. SOIL & MEDIA

Cropping in soil without rotation of EVERY crop can result in severe disease pressure, unless soil is fumigated or steamed, however this is often fully effective in sandy soil. With the prohibition of the use of methyl bromide in many countries, a number of other fumigants have been used, including **Vapam** (metham sodium), **Basimid**, best used at a high rate, and **Chloropicrin**. **Telone** has been used to combat nematodes, but is not particularly effective against fungi.

Successful fumigation is dependent on soil temperature and is best applied prior to winter for spring planting.

Steam can work effectively in sandy soils but is limited in penetration unless suction pipes are installed at least 60cm below ground level (commonly used in Holland).

Untreated pine sawdust, composted bark, coco peat, peat moss, rice husk, and volcanic gravels area all used as hydroponic media and are now a preferred option by many growers, however daily nutrient status must be very closely monitored as buffer levels are severely reduced.

4. EC (Soil Salt level)

High salt levels can damage sensitive new roots. *Erwinia* bacteria can then attack damaged tissue and result in soft rot and plant breakdown.

Optimum soil/media EC is 0.9 - 1.8. This will vary through the various stages of the crop – vegetative leaf establishment, flowering and tuberisation.

EC levels greater than 2.0 can be excessive and plants may suffer losses. Take care when drying off as EC may rise sharply, and cause root burn leading to pathogen infection.

Solution

Apply fertilizer according to soil test results and within recommended limits. Slow release NPK products like **Osmocote**® and **Nutricote**® work well, along with regular liquid feed applications.

Check EC daily. Use readily soluble N fertilisers (eg. CAN, DAP) at modest amounts. Use nitrate (NO₃) sources of N instead of ammonium (NH₄) sources. Monitor N-K ratios throughout the growing cycle.

Treatment for high EC - reduce nutrient and flush affected area with water to reduce the soluble salts. Stabilise to normal moisture levels then flush again. Resume normal watering once soil moisture has returned to acceptable levels.

5. FUNGAL PATHOGENS

Primary fungal pathogens – *pythium*, *rhizoctonia*, *fusarium*, and *phytophthora* can all cause damage to plant and root tissue during plant stress, providing entry for *erwinia* and subsequent soft-rot.

Solution

Treatment of tubers with **Previcur**®N prior to planting (mixed with GA) is an effective preventative. In the USA a pre-plant treatment of **Champ**® or **Kocide**® (copper hydroxide), **Heritage** (Azoxystrobin) and **Subdue**® or **Ridomil**® (metalaxyl-M) is commonly used.

Other combinations such as **Collis**® (Boscalid & Kresoxim-methyl), **Topsin**® (Thiophanate Methyl) and **Risolex**® have been used successfully.

Addition of an insecticide such as **Confidor** or **Admire** (Imadocloprid) will help prevent attack from soil borne insects.

In semi-hydroponic media, pre-plant incorporation of suitable fungicides (**Ridomil**®, **Risolex**®) will give effective early crop protection for up to 4-6 weeks.

A preventative spray programme throughout the crop cycle with **Kocide**® (2-3g/l) or **Phyton27**® can help manage bacterial & fungal infections, especially in damp humid conditions. Don't use when flowers are open as staining will occur.

An organic approach using **Trichoderma**™ and other beneficial bacteria like compost teas can be used, but have had varying results.

Pythium attacks roots. Healthy calla tubers have strong, white branching, contractile roots. Roots from a healthy tuber may travel up to 30cm. When *pythium* attacks roots are initially affected by pink lesions, then turn opaque and eventually rot.



Root lesions (infection & damage)

Pythium is water and dust-borne; and 'halo' like patches of plant death often occur 10 days after rain and initial infection. This can result in stress and secondary *erwinia* attack.

Even a minor *pythium* attack can affect 30-50% of the fine feeding roots even though sections of the root are left intact.

Prevention and Treatment

Following pre-planting incorporation of fungicide, drench with **Ridomil**® after rain, particularly where irrigation is reliant on untreated river or pond water. **Ridomil**® should be limited to 2-3 times in any crop cycle. Treatment with carbendazim (**Bavestin**®, **Protek**®) has also been successful.

Effective foliar applied preventatives include Phosphorous Acid formulations (**Fostonic 80WP**®, **Foli-R-Fos**®, **Foschek**™ or **Phosgard**™) or **Aliette**® (fosetyl aluminum).

Aliette® should be used sparingly as repeated applications may affect plant performance. Take care where copper residues are present on leaves as a phytotoxic reaction can occur.

Rhizoctonia results in basal stem rot of the growing plant causing leaf and shoot collapse. A clear symptom is curling leaves, which is very obvious in narrow leaved varieties.



Typical symptoms of rhizoctonia

Prevention and Treatment

Soil drenches during the crop cycle can include a mixture of fungicides to provide broad spectrum action against the range of soil borne fungal pathogens that affect callas. Use **Ridomil**®, **Risolex**®, **Maxim**® (fludioxonil).

Collis® is a successful preventative systemic fungicide which is applied by conventional high pressure spraying or thermal fogging.

6. BACTERIAL PATHOGENS

Pseudomonas blight can attack the leaf area of the plant in cold damp conditions, especially when the crop canopy is heavy and the greenhouse unventilated.

Leaves become translucent and turn to a slimy mush and may lead to further bacterial infection. Remove infected material and treat with **Mankocide DF**® (mancozeb & copper hydroxide) or **Kocide**®. Dry the leaf canopy as rapidly as possible.

7. SLIMY STEM IN FLOWERS

Erwinia can affect flowers post-harvest. Often referred to as slimy stem, the surface of the lower part of the stem turns pink and mushy and is characterized by the foul smell of bacterial collapse.

Solution

Remove any diseased plant material from the crop on a daily basis. Pick flowers dry.

Harvested flower stems showing any bacterial breakdown should be thrown out and infected buckets/equipment re-sanitized.

Care with crop hygiene, washing buckets with bacteriostat and regular sanitation of packhouse equipment is essential during flower harvest.

Ensure hydration solution is clean, treated water. Add **Keystrepto**™ (streptomycin), or **Enhance**™ (2-3ml/20l) to protect against slimy stem and increase vase life. Do not use sugar based preservatives.

8. TUBER STORAGE

Erwinia can be a significant problem immediately after tuber lifting and during the early curing process. If tubers are lifted immature, during wet conditions or are washed, they need to be dried very rapidly to reduce moisture and high humidity, to avoid bacterial attack and tuber mortality.

Handling damage to the surface skin of the tuber prior to full curing can lead to infection and onset of softrot. An excellent pre-cure spray is DuPont™ **Virkon**®S - also very effective for disinfecting machinery.

Use of high velocity drying fans and commercial dehumidifiers is essential to achieve sufficient drying.

SUMMARY

The key to reduction of *Erwinia* in *Zantedeschia* is prevention, from storage prior to planting through to flower and tuber harvest, using an integrated management system.

Once an attack has occurred it becomes increasingly difficult to halt further contamination, especially if environmental conditions predispose to *erwinia*.

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