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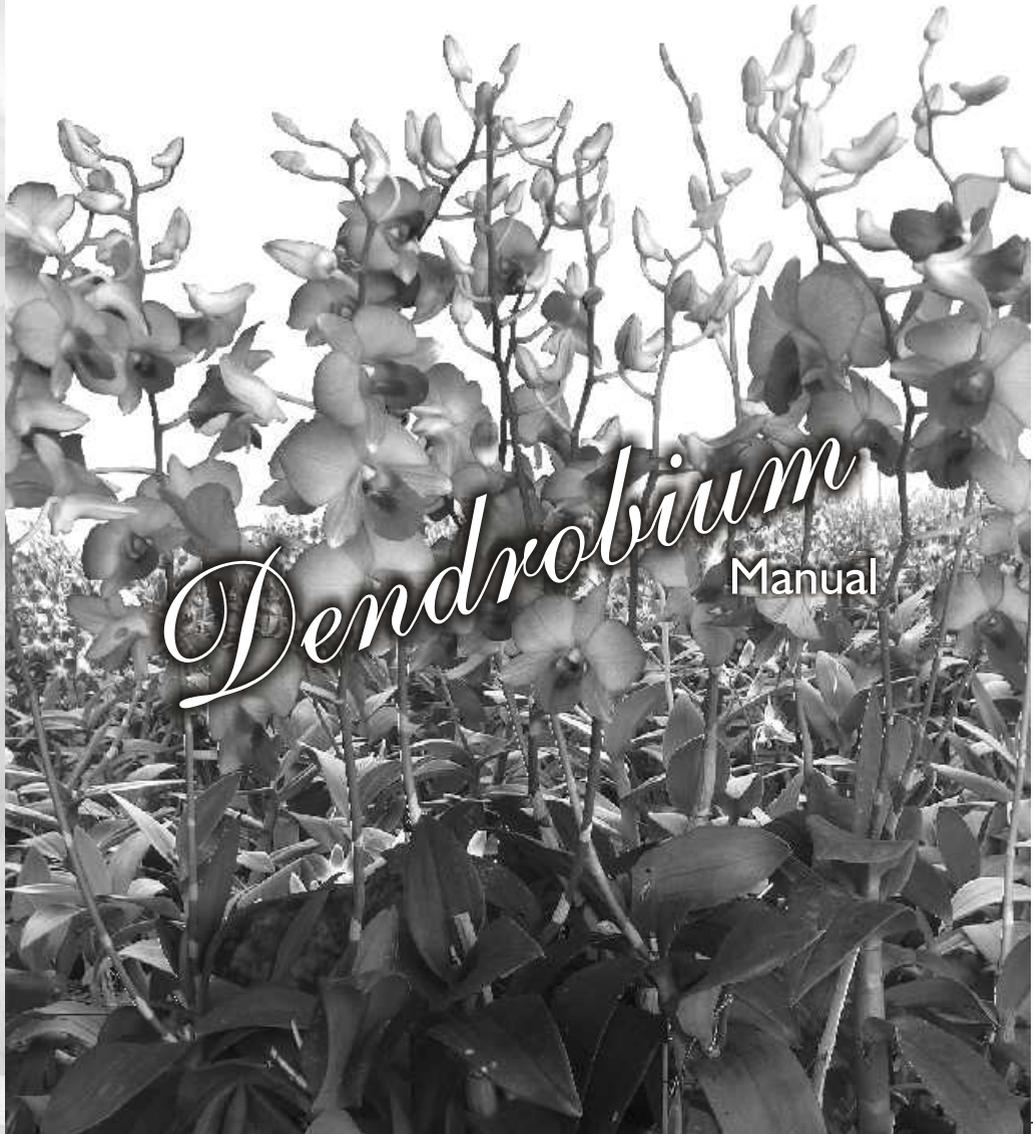
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A black and white photograph of a field of Dendrobium orchids. The plants are tall and slender, with many buds and some open flowers. The background is a bright, overcast sky.

Dendrobium

Manual

DENDROBIUM CULTIVATION

INTRODUCTION

Dendrobium, belonging to family Orchidaceae, is the largest genus of Orchids. In general, Orchids are most abundant in the tropics and sub-tropics, where the conditions are favourable for the growth of Orchids. The tropical species are mostly epiphytic and the largest epiphytic genus is Dendrobium.

Orchids have occupied a significant position in the world cut-flower industry for their attractive, beautiful range of colours, variation in shape and long shelf life.

GROWTH HABIT

Based on the growth habit, Orchids are grouped into two types, viz, sympodial and monopodial.

Sympodial growth habit: The plants produce a thick bulb-like structure, known as pseudo-bulb, which usually grows along the rhizome. Examples are Dendrobium, Cattleya, Oncidium and Bulbophyllum.

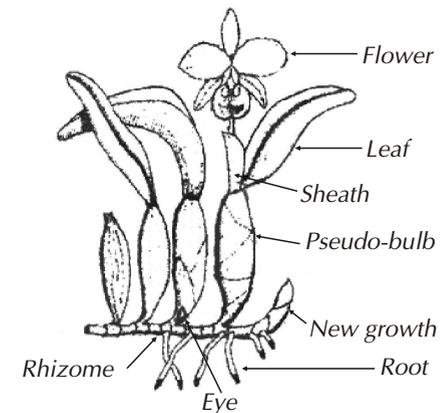
Monopodial growth habit: The plants produce one main stem that grows taller every year. The stem elongates, adding new leaves to the top and aerial roots arise occasionally from the main stem. Examples are Vanda, Vanilla, Rhyncostylis, Arachnis, etc.

PLANT MORPHOLOGY

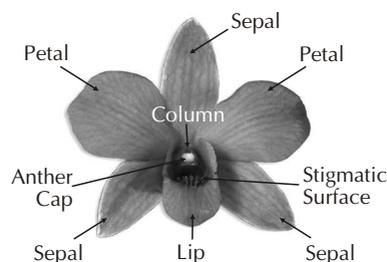
Root: Epiphytic Orchids have modified aerial roots. The roots are made up of several layers of epidermal cells modified into shiny, spongy, water-absorbing structure. A remarkable feature of epiphytic Orchid roots is that they contain Chlorophyll and participate in photosynthesis.

Leaf: In most epiphytic Orchids the leaves are thick and leathery with a waxy coating to help in minimizing water loss. The leaf color can be used as an indicator of the amount of sunlight received by the plant. The ideal colour should be somewhere between light green to dark green.

Pseudo-bulb: These are specialized water storage organs to survive in extreme climatic conditions. These are formed by swelling of one to many internodes of the stem. The pseudo-stems are often conical or oblong in shape and have smooth surface with lengthwise grooves. Shriveling of the pseudo-stem is an indication that the plant is subjected to water stress. With ageing, the pseudo-bulb sheds its leaves and becomes dormant. At this stage, it is called a 'back bulb'.



Flower: The typical Orchid flower is zygomorphic i.e., bilaterally symmetrical. The Orchid flower consists of three sepals and three petals that are arranged in a whorl and a reproductive column. Individual flowers are borne on spikes, that arise from where the outermost leaf meets the pseudo-bulb.



CLIMATE

Dendrobiums can adapt themselves in a wide range of climatic and topographic conditions varying from hot, wet lowlands to high altitude colder regions. The genus prefers bright light to produce quality blooms.

Temperature

Based on the suitability to the range of temperatures, for growth and development, Dendrobium belongs to the group of tropical (warm) Orchids. Temperatures ranging between 20°C - 30°C during the day and 16°C - 20°C during the night are suitable. Temperature below 20°C for prolonged periods leads to leaf drop. Sunlight and sufficient humidity levels help Dendrobium Orchids endure cooler daytime temperatures. Under shade net conditions, the plants can survive upto 35°C.

Light Intensity

The light requirement ranges between 25,000 - 38,000 Lux. The exposure of leaves to direct sunlight should be avoided as this leads to scorching of the leaves, and the growth and flowering gets adversely affected.

Relative Humidity

A relative humidity of 50% - 60% is ideal. Foggers are installed and operated to maintain the humidity at desired levels.

VENTILATION

Fresh air circulation is a mandatory requirement throughout the growth of the plant. Proper ventilation helps in maintaining uniform temperature inside the greenhouse. Lack of ventilation creates hot humid pockets inside the greenhouse which is a pre-disposing factor for the incidence of disease-causing pathogens.

POLYHOUSE / SHADE NET

The structure of the polyhouse will vary depending on the geo-climatic location. Structural modifications are suggested for different regions to meet the crop growth requirement. In heavy rainfall areas, shade net is not recommended. The general polyhouse specification is as follows:

- **Height:** 6 m, Gutter height: 4.5 m, Bay Size: 8 x 4 m
- **Plastic:** 200 microns - white diffused.

- **Overhead Top Shade Net:** A shade net is installed over the top plastic in areas having prolonged periods of high light intensities and high temperature.
- **Overhead Top Sprinkler:** This aids in bringing down the temperature in high temperature areas.
- **Inner Top Shade Net:** 50% shade net, green/white.
- **Side Shade Net:** 45% mono-filament green/white.
- **Rollable Side Curtains:** These curtains, along the sides, serve the purpose of maintaining the relative humidity at desired levels. In areas where the relative humidity is very low, the curtains can be rolled down to bring the humidity to the desired level. In high humid areas, the curtains are rolled up, to enable ample air circulation. **The operation of these curtains is a crucial factor in maintaining the humidity of the greenhouse.**

PLANTING STRUCTURE

Raised benches are erected on which planting takes place on netted platforms. The benches can be supported on cement pole stands or on GI pole stands. The advantage of the GI pole stand is that it can be fabricated as per requirement and is easy to modify. 50% mono-filament green shade net serves as the netted platform. The durability of the netted platform is of paramount importance, as it is this platform that holds the weight of the plant till the end of the crop lifecycle. The bench specifications are as follows:

- **Height:** 70 cm, **Width:** 1.2 m, **Pathway:** 1 m.

MEDIA

The role of media in Dendrobium is largely to help the roots to anchor, thereby providing support for growth. The media should also be such that it lets off moisture, thereby keeping the root zone of the plant well aerated. In Dendrobium, coconut husk is the media that is widely used. Since the coconut husk is procured from coastal regions, the content of Sodium in the husk is normally beyond the permissible limits for healthy plant growth, hence the coconut husk needs to be pre-treated to remove the excess Sodium.

Pre-planting treatment of coconut husk to remove excess Sodium:

The husks need to be treated with Calcium Nitrate @ 3 gm / lit. of water to remove the Sodium ions from the husk.

Procedure:

Step 1: Soak the coconut husk in plain water for 3 to 4 hours. Drain out the water. The water used for soaking should not have EC of more than 1 mS/cm.

Step 2: Soak the coconut husk in Calcium Nitrate, overnight @ 3 gm / lit. Drain out the solution.

Step 3: Wash the coconut husk with water.

Repeat the Calcium Nitrate treatment till the EC of the husk comes down to 0.3 - 0.5 mS/cm.

Pre-planting treatment of husks and plants to eliminate pests or disease-causing organisms:

In most cases, the husks are piled up and stored, which increases chances of the incidence of snails and slugs. The husks need to be treated to kill the eggs and adults of this pest, which is a major threat to this crop.

Procedure: The chemical combination for pre-planting treatment includes the following:

- Captan @ 2 gm/lit + Imidacloprid @ 0.5 ml / lit + Metaldehyde @ 20 gm / lit. The husks as well as the plants are dipped in this mixture of solution for 5 - 10 seconds.

PLANTING

Before planting, the husks need to be arranged on the benches. There are various patterns of arrangement of husks. One of the simplest and most common methods is the back-to-back arrangement of the husk.



Back-to-back arrangement of husk



Twines running along the beds

A minimum of 4 twines run along the bed, which is used to fasten individual plants and hold them in position. As the plant grows and more pseudo-stems are formed each year, the base would require more support, hence additional husks need to be added at the base, just enough to hold the entire plant erect. After planting, the husks need to be given a light showering with plain water. Thereafter, from the next day onwards the post-planting schedule needs to be followed. The post-planting schedule of two weeks is followed to acclimatize the plants to the new environment, which essentially includes fungicides, bactericides and N:P:K balanced nutrient.

PLANT DENSITY

The plant population per acre is 36,000 with a density of 17 plants / m². The planting specifications are as follows:

- Number of rows per bench: 4
- Row-to-row distance: 30 cm
- Plant-to-plant distance: 20 cm

IRRIGATION AND FERTIGATION

The performance of the plants in the greenhouse is a combined effect of the light, temperature, humidity and fertigation. The pH of water used for irrigation should be within the range of 5.2 - 6.2, and the EC should not exceed 0.7mS/cm. The frequency of irrigation depends on the growing condition and wetness of coco chunks. Occasional misting of the foliage will help in maintaining the moisture lost during very warm days.

Irrigation and fertigation is carried out with the help of a hand shower. If the media appears wet and soggy, fertigation should be temporarily stopped. Over-watering will increase the incidence of fungal diseases. The frequency of irrigation varies with each season. In general, under optimum greenhouse conditions, fertigation is given thrice a week. For better utilization of the fertilizer solution, the husks need to be given a light showering a day prior to fertigation.

Nutrition Guidelines:

- Planting upto 4 months: NPK ratio - 3 : 1 : 1
- 5th - 7th month : NPK ratio - 1 : 3 : 1
- 7th month onwards : NPK ratio - 1 : 1 : 3
- The pH should be maintained between 5.5 - 6.5, and EC during the vegetative stage should be around 1.2 and can go upto 1.8 mS/cm.
- Weekly drench of CaNO₃ @ 2 gm/liter.
- Care should be taken to prevent salt build-up in the media. To avoid salt build-up, frequent washing of the media with water having EC less than 0.7 mS/cm can be carried out.
- Do not spray fertilizer on flowering spike or spikes with buds.

During monsoons, the rate of evaporation of moisture from the husk takes place at a lower rate, due to reduced light, hence the fertigation frequency is reduced. During summers, the coco-husk dries up rapidly, hence to maintain optimum moisture levels in the husk, light showering with plain water is to be given, to prevent the plants from getting subjected to water stress. The indication of water stress is the plants getting placid and the pseudo-stem showing a shriveled appearance. Similarly, during winters, the light levels and temperature is below optimum, which will slow down the plant growth. However, if the plant is in the production stage, a month prior to the onset of winter, the fertigation needs to be revised which essentially includes higher dosage of Phosphorus and Potassium.

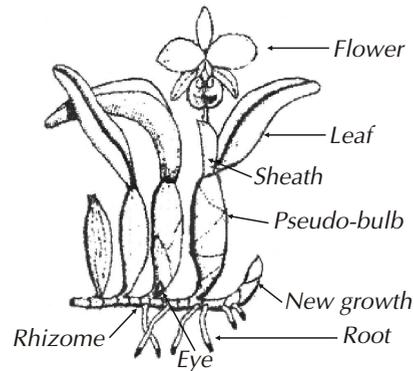
MAINTAINING OPTIMUM HUMIDITY

Humidity levels need to be maintained at optimum levels at all times. It is the optimum humidity levels in a greenhouse that help in the proper uptake of nutrients. During monsoons, the high humidity levels can lead to fungal infection, hence maintaining adequate ventilation is of paramount importance. During winter, the humidity levels dip to low levels. Under such situations, the foggers need to be operated at frequent intervals and the side curtains need to be rolled down to maintain the humidity levels inside.

However, this operation needs to be carried out depending on the existing local climatic conditions. The thumb rule is to avoid stagnant humid air build-up in the greenhouse. While operating the foggers, ensure that the water droplets do not reach the plant canopy level. Keeping the ground area, i.e, the area beneath the bed wet increases the humidity, thereby improving the plant performance.

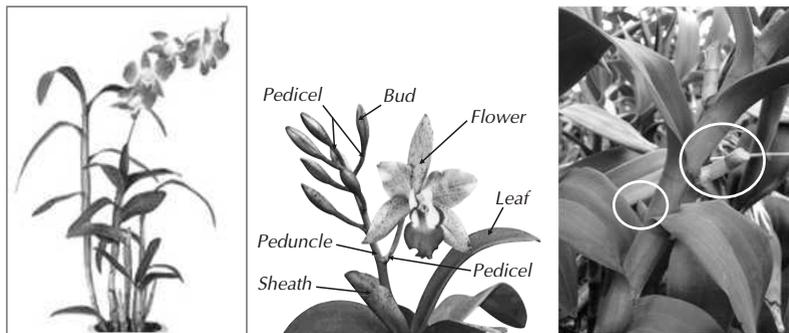
GROWTH AND FLOWERING PATTERN

Dendrobium Orchids have sympodial growth pattern, which means that the Orchid grows laterally. The lateral growth produces new shoots along the rhizome that develops into a stem with roots and leaves which eventually produces flowers. This growth process is repeated in a continuous cycle.



Lateral growth pattern of Sympodial Orchid

Flowering: Under optimum growing conditions, a hardened plant having a height of 10 - 12 cm, should come to flowering in 4 - 5 months after planting. The cane puts forth flowering shoot only after attaining full maturity. The first flowering shoot or the spike arises from where the outermost leaf meets the pseudo-bulb. The emergence of the flowering spikes is from top to bottom of the matured cane.



First flowering shoot emerging from the topmost leaf axil

Flowering shoot

Buds of flowering shoot emerging opposite to the leaf axil

Dendrobiums put forth flowering buds, from the sides of the canes, generally opposite the leaf axils. During the first year of plantation 1 - 2 new canes will be produced per plant. These canes will produce approximately 3 - 4 small flower spikes per cane. These flower spikes will bear an average of 5 florets each. With the subsequent years, the number of canes produced per plant will increase, accompanied by increase in the number of spikes as well as the length of the spikes. Under optimum growth and management conditions, a 3 - 4 year old plant, should produce 8 - 10 spikes, bearing 10 - 11 florets each.

HARVESTING

The premium quality spikes are those having a length of 60 cm and bearing 10 - 12 florets each.

Harvesting should be carried out during early morning hours, by snapping the base of the spike, when more than 50% of the florets are open.



Stage of harvest



Point of harvest



Fully harvested cane

POST-HARVEST GUIDELINES

Step 1:

Post-harvest care and operations will vary, depending upon the season and the market distance. After harvest, the spikes are given an angular cut by placing the stems in water. (The angular cut should be given with the stem being immersed in water). The stems are then graded as per the length of the spike. The grading criteria are as follows:

Parameter	Size			
	Super Long (SL)	Long (L)	Medium (M)	Short (S)
Spike length / Stem length (cm)	55 and above	45 - 54	35 - 44	30 - 34
Flowers per stem	12 - 15	10 - 12	8 - 10	6 - 8
Number of opened flowers per stem	7	6	5	4

Step 2:

After grading, the spikes are subjected to 'Pulsing Treatment'.

Pulsing Treatment: The spikes are placed in a solution of 8 HQS - Hydroxy Quinoline Sulphate (@ 225 mg / lit) + Silver Nitrate (@ 30 mg / lit) + Sucrose (@ 40 gm / lit) for a period of 2 hours. A minimum of 3 lit solution is required for placing around 30 medium sized spikes per bucket.

Step 3:

The Pulsing treatment is followed by placing the stems in 'Holding Solution'. This step is carried out for dispatches to distant markets. The Holding Solution comprises of 8 HQS - Hydroxy Quinoline Sulphate (@ 200 mg / lit) + Silver Nitrate (@ 10 mg / lit) + Sucrose (@ 20 gm / lit). This solution is filled into vials and individual flower spikes are placed in each vial.

Step 4:

The flower spikes are bunched together @ 20 spikes / bunch. This is followed by covering each bunch with plastic sleeve.

Step 5:

The sleeved bunches are packed into corrugated boxes and ready for transport. The box size is 100 cm (L) x 30 cm (W) x 40 cm (H). 700 medium sized spikes (35 bunches) can be arranged per box.



Sorting and Grading



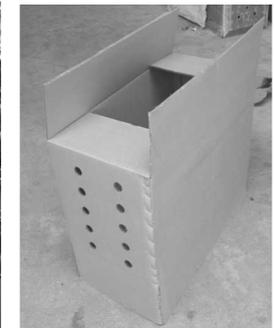
Bunching



Bunching and Packing for local dispatch



Packing and dispatch in vials for distant markets



Packing Box

Insect Pests

Pest	Pre-disposing factors	Symptoms	Remedy
Snail / Slugs	The coconut husk is the main source of snail eggs and adults. Hence the husk needs to be treated before laying them on the benches. High moisture content in the husks will harbor snails.	Shot hole feeding symptoms on the flower petals. The roots will be eaten off from the growing tip.	Eliminate the hiding places. Baits to trap the adults can be placed on the benches as well as beneath the benches. The poison baits contain Metaldehyde. Certain other baits like Jaggery will serve as attracting the adults which will have to be collected and destroyed manually.
Caterpillar	Multiply rapidly during monsoons, owing to high humidity.	Feeding damage symptoms seen on the flower petals and tender leaves. Caterpillar droppings will be visible on the flower as well as media, as the larvae hide in the media or leaf sheaths during the day time.	Maintain ample air circulation and prevent humidity build-up by allowing accumulation of stagnant air inside the greenhouse. Spray with Lannate (Methomyl) @ 1.5 gm / lit.
Scales, Mealy bugs and Thrips	Lack of air circulation.	Thrips suck sap from the petals, hence the tissues of the petals dry out and turn brown. Scales and mealy bugs will feed and thrive on the leaf axils and tender growing points. Sooty mold develops on the leaves.	Provide ample air circulation. Maintain optimum humidity levels by operating the foggers. Confidor (Imidacloprid) @ 0.5 ml/lit, Acephate @ 1.5 gm/lit, Rogor (Dimethoate) @ 2 ml/lit.
Mites	Hot and dry conditions.	Feed on the underside of the leaves. The leaves appear streaked or spotted due to lack of chlorophyll. In severe cases of mite population, webbing is observed.	Maintain optimum humidity levels in the greenhouse. If heavy infestation, spray the plants with strong jet of plain water to dislodge the mites.

Diseases

Disease	Pre-disposing factor	Symptoms	Remedy
Bacterial soft & Brown rot	Hot moist conditions in the greenhouse, overwatering, low light levels, infected tools, contaminated water.	Symptoms begin on the leaves as water-soaked spots, with yellow margins, having an oily appearance. As the disease advances, the leaves will loosen from the pseudo-stem, emit foul odour, apart for the slimy ooze that comes out of the tissue.	Since spores are spread by water splash, avoid overhead watering if disease is present. Under situations of severe outbreak, reduce humidity levels in the greenhouse. Streptocyclin spray @ 0.2 ml / lit, H ₂ O ₂ + Silver @ 2 ml / lit.
Pythium and Phytophthora rot	Excessive moisture in the media.	Irregular brown spots appear on the under side of the leaves initially, which later turn purplish brown in colour. As the disease advances, the plants wilt. Infection often starts in the roots and spreads upward.	Prevent overhead showering as the fungal spores will spread rapidly to healthy plants. Bavistin (Carbendazim) @ 2 gm / lit, Metalaxyl @ 1 gm / lit.
Rhizoctonia Root rot	Overwatering, high humidity and low temperature.	Blackish brown discoloration of the neck of the roots.	Cut and discard the affected roots & drench the plant with Topsin-M (Thiophanate Methyl) @ 2 gm / lit, Captan (Captaf) @ 2 gm / lit, Metalaxyl @ 1 gm / lit.
Anthraco	Stagnant air, high temperature and low light intensity.	Leaf tip turns brown and the browning progresses towards the base. Concentric rings appear around the dark brown or grey patches on the leaves.	Topsin-M (Thiophanate Methyl) @ 2 gm / lit.
Cercospora Leaf spot	High humidity, stagnant air.	Infection begins as yellow spots on the under side of the leaves, which later gets visible on the upper side as well. The spots enlarge and cover the entire leaf, turning the leaf chlorotic and eventually necrotic.	Provide optimum humidity level. Dithane M-45 (Mancozeb) @ 1.5 gm / lit.
Botrytis Petal Blight	High Humidity and moisture retention on the petals for prolonged periods.	Very small, light brown or black spots on the flower petals. Under very high humid conditions, fungal growth can be observed on these spots.	Provide ample ventilation. Dithane M-45 @ 1.5 gm / lit.

Non-Pathogenic damage

1. Sun burn:

Exposure of leaves to too much light for prolonged period. Characterized by the sudden appearance of black spots on the leaves.

2. Mesophyll cellular collapse:

Sudden cold temperature or watering the plants with cold water. Burn-like symptoms appear in patches on the leaves.

3. Salt Burn:

Deposition of fertilizer salts on the flower petals, leading to burning of the flower petals.

4. Edema:

Blister-like lesions on the upper or lower surface of the leaves, stem, flower petals etc. Occurs when plants are watered during warm days and the nights turn cool or during periods of cool weather when water quantity and/or frequency is not reduced. Excess water is absorbed by the roots, quicker than it is lost by the leaves, causing swelling of plant cells and producing blister-like lesions.
