Crop: Azalea
Scientific Name: Rhododendron spp.
including: R. indicum, R. simsii, R. mucronatum, R. obtusum (Ericaceae)

I. Introduction

A. The azaleas used for forcing are only a small segment of the genus Rhododendron. The genus is broken into 43 series of which azalea is but one. This series is composed of 6 subseries, of which the evergreen forcing azaleas are derived from one, the 'Obtusum' subseries.

B. Nine species have been used for breeding, probably the most important being *R. obtusum, R. indicum, R. mucronatum,* and *R. pulchrum.*

C. Azaleas normally require a long time period to grow from propagation to sale (2 years).

II. Cultivars, Clones, Breeding, Development

A. Numerous species are grown and generally cultivars are broken into 4 groups.

1. Indian (Indica) - This group includes not only inter-specific hybrids but also selections within *R. indicum, R. simsii,* and *R. mucronatum. R. indicum* is native to southern Japan - not India or China as some authors claim. Most hybridizing on this group was done in Europe, especially by the Belgians. Flowers are single, many are striped or flecked. Cultivars include 'Jean Haerens Albert', 'Elizabeth' and 'Paul Schame'.

2. Kurume - These cultivars are all derived from *R. obtusum.* These azaleas were originally found in and around the Japanese city of Kurume. Flowers are single, small, and range from white through red. Plants are very floriferous and are among the hardiest of the forcing azaleas. Cultivars include 'Coral Bells', 'Hexe', 'Snow', and 'Salmon Beauty'.

3. Pericat - No record of parentage exists for the Pericat hybrids. They may have been derived from Indian and Kurume hybrids. Noted for clarity of color, good form of flowers and habit. Flowers are carmine to purple. Cultivars include 'Sweetheart', 'Supreme', 'Marjory Ann',

'Rival', and 'Rose Pericat'.

4. Rutherford (R. x rutherfordiana) - First azaleas patented in the U.S. Resulted from crosses between 'Indian' and 'Kurume' varieties. Color range from orange, red, purple, to white. Cultivars include'Alaska', 'Rose Queen' and 'Snow Queen'.

B. 'Roadrunner' and 'Chimes' are widely grown cultivars.

III. Flower Induction Requirements

A. When azalea initiate flower buds, all floral parts are formed but the bud remain dormant. A period of cool temperatures is normally required for further flower development.

B. Flower initiation is controlled by temperature which interacts with photoperiod.

1. The optimal temperature for bud initiation and development is 18°C (65°F) or above.

2. At higher temperatures, long days delay floral initiation while short days hasten it.

3. At lower temperatures, photoperiod has little effect. Development is delayed compared with 18°C (65°F) temperatures.

4. A night temperature of 16-18°C (60-65°F) is generally accepted as a minimum temperature for initiation and development.

C. Growth retardants such as Cycocel and B-Nine hasten flower bud initiation. B-Nine is sometimes applied in conjunction with short days for early season forcing.

D. Further development of the dormant buds requires a cool temperature period at 7-10°C (45-50°F) for 6 weeks (Indian cultivars). Subsequent forcing at 18°C (65°F) results in rapid flowering.

IV. Environmental Requirements

A. Light

1. Quantity

a. Full light intensity is acceptable during the winter for growing or forcing.

b. Shading should be used to restrict light intensity to 3,000-4,000 footcandles (600-800 μmol $s^{-1}m^{-2}$) during the April to October period during growing.

2. Duration

a. Short days can be applied 3-4 weeks after a B-Nine application to induce flowers.

b. During vegetative growth, long day should be kept through the time of B-Nine application.

c. To keep plants vegetative, plants should be kept lighted from September 1 to March 31 for year around programs.

B. Temperature

1. Maintain 18°C (65°F) night temperature during vegetative growth.

2. During flower induction and development, minimum temperature should be 18°C (65°F) night.

3. The cold treatment is given at 4-9°C (40-48°F) day and night temperature. To prevent leaf abscission, 10 foot-candles of light for 12 hours per day is required during the cool treatment. Some cultivars can be kept in the dark without leaf drop at 4°C (40°F).

4. Suitable forcing temperatures are 16-18°C (60-65°F).

C. Water

1. Plants should be kept moist but not excessively wet at all times.

2. The water source should be low in soluble salts, i.e. below 0.6.

D. Nutrition

1. Tip burn easily occurs on new foliage with high soluble salts and care must be exercised to avoid high soluble salts.

2. N-P-K in the ratio of 3:1:1 (21-7-7 or 30-10-10) and ammonical forms of nitrogen are preferred.

3. Adequate N is 200 ppm at every other watering with one plain watering in between.

4. Low pH is easier maintained with an ammonium fertilizer (acidic) than calcium nitrate (alkaline residue).

5. Iron deficiency can easily occur in a cold, wet medium.

6. Soluble salts should be kept below 1.0 on a 1:2 dilution soil test.

a. Iron can be applied as chelated iron (10-15% iron) at 3.5 oz/100 gal water.

b. Alternatively, iron sulfate (ferrous sulfate) can be applied at 3 lb/100 gallon water.

E. Gases

1. Carbon dioxide at 800-1000ppm is beneficial during vegetative growth and flower development.

V. Cultivation

A. Propagation

1. Cuttings

a. Most azaleas are propagated from semi-hardwood cuttings.

b. Healthy stock plants should be used. Discard diseased or wilted cuttings which fail to regain turgidity.

c. Cuttings are taken in the spring and are usually 5-10 cm (2-4 inches) long.

d. The rooting medium should be sterile, well- drained, and porous.

e. Maintain air temperature at least at 16°C (60°F) and bottom heat of 21°C (70°F).

f. Humidity should be maintained as high as possible by using intermittent mist.

g. Long days (18 hr) should be provided and light intensity should be reduced by shading, especially in the summer.

h. Rooting occurs within 5-10 weeks.

2. Grafting

a. Only a small number of azaleas are grafted - mainly for tree forms.

b. *R. concinnum* is used as an understock. Cuttings are rooted in the spring and grown for 1 year. Plants are selected to a height of 30 cm (12 inches) or 45 cm (18 inches).

c. Five cm (2 inches) of scion wood is side grafted on the rootstock.

d. Grafted plants are placed under mist for 2 months to allow a graft union to form.

e. After the scion begins growth, it is treated (pinched, etc.) as any other azalea plant.

f. Two years are required from grafting to sale of a flowering plant.

3. Alternatives for producers of azaleas

a. The grower propagates cuttings from stock plants. Normally profitable for growers in northern states.

b. Liners are small plants with good root systems, that have been grown for several months by the propagator. Liners can be planted in 10 cm (4 inch) pots and grown with 1-2 pinchers.

c. Growing-on plants are larger plants ready for potting in 15-18 cm (6-7 inch) pots, but without flower buds. The plants are grown until flower buds are formed and then given the necessary low temperature treatment.

d. Pre-finished, budded but not yet cooled plants. These plants are of final size with flower buds, but need a cold treatment for breaking of bud dormancy.

e. Pre-finished, budded and cooled plants are ready for forcing in a greenhouse. The required forcing time is 4-8 weeks.

B. Medium and Planting

1. Azaleas grow best in an all-peat medium at a pH of 4.5-5.5.

2. Cuttings are rooted in flats or plugs initially.

3. Plants are then transplanted to 6 or 7 cm (2 1/2 - 3 inch) pots (liners).

4. Liners are shipped from propagators to growers and are planted in 15 cm (6 inch) pots.

C. Spacing

1. Liners are initially grown pot to pot.

2. Plants in 15 cm (6 inch) pots can be grown pot to pot initially, but must be spaced at a minimum of 25 x 25 cm (10 x 10 inches) before the final pinch.

D. Support

1. None for standard plant.

2. Bamboo stake is necessary to help support grafted tree forms.

E. Pinching

1. Hand pinching

   a. Liners are pinched 2 to 3 times before being shipped to the grower.

   b. Liners received by the grower should be potted and pinched 10-14 days later.

   c. An additional pinch may be necessary about 2-3 months later to obtain large plant size.

   d. At pinch, the terminal growing point should be removed down to the uppermost maximum sized leaf. In general, this means about 1 to 2.5 cm. (1/2 to 1 inch) of growth.

   e. Pinch the plant to rounded or dome-shaped rather than flat across the top.

2. Chemical Pinching

   a. Off-Shoot-0 is a mixture of fatty acid esters used to induce pinching.

   b. The chemical works by killing the young tissue while leaving the older, mature tissue intact.

   c. It is important that the material is evenly distributed on the plant and applied under conditions with good air circulation.

   d. Results can be variable, depending on cultivar, plant condition, time of day and year, temperature, and humidity.

   e. The advantages are labor savings and larger plants, as less new growth is removed and more shoots can develop per terminal.

   f. The main disadvantage is unpredictability.

   g. Atrinal is sometimes used in combination with Off-Shoot-0.

3. Mechanical pinching

   a. Plants are sheared with a mechanical device such as a hand

held grass clipper.

b. Mechanical pinching is relatively fast, but some shoots are often missed, which results in uneven growth.

4. Bypass shoots are vegetative shoots that develop below the flowers. These shoots need to be removed, as they reduce quality and may cause flower bud abortion.

a. Removal by hand is labor intensive.

b. Good control of bypass shoot elongation has been achieved by foliar sprays of Bonzi at 100-200 ppm. The application should be made when the bypass shoots are barely visible.

F. Disbudding

1. None

G. Growth Regulators

1. B-Nine and Cycocel, when used in conjunction with short days, induce earlier flower bud formation.

a. The suggested rate of B-Nine is to apply 2 applications at 2,500-3,500 ppm, 1 week apart, 4 to 6 weeks after last pinch.

b. There are some indications that Cycocel may delay the development after the cool temperature treatment.

2. Gibberellins

a. Gibberellins may be used as a substitution for insufficient cold, but use is not a standard practice.

b. Apply 3 weekly sprays at 250 ppm at the beginning of forcing if plants have only received 3 weeks of cold.

c. If no cold has been given, apply 1,000 ppm weekly for 5 weeks.

d. GA_3 or GA_{4+7} both are effective.

e. Unlike cooled plants, development typically is not as uniform.

VI. Problems

A. Insects

1. Spider Mites

   a. The two spotted mite (*Tetrancyhus urticae*) is a common pest. The foliage becomes yellowed or bronzed and may become covered with webbing. Repeated applications of pesticides may be required to control all stages of development.

   b. Cyclamen mites (*Steneotarsonemus pallidus*) can also attack azalea. Growth is twisted and distorted.

2. Lace bugs (*Stephanitis pyrioides*). Insect feeds on undersides of leaves, removing cell contents. Leaves become bronzed with small, shiny, tar-like black spots of excrement and cast nymphal skins covering the lower leaf surface.

3. Thrips, leaf miners, aphids and whiteflies may occasionally infest the plants, but are usually not devastating to the plants.

B. Diseases

1. *Cyclindrocladium* blight is the most serious azalea disease. This disease may destroy cuttings during rooting or infect the plant, causing plant death several weeks or months later. The stems and roots become girdled and the plants wilt rapidly. Control by good sanitation of the propagation area and medium, and removal of infected plants.

2. *Phytohpthora* root rot, also known as azalea decline or little leaf disease. These names indicate the symptoms of the disease that may be causing damage over several seasons. The disease is especially severe if the growing medium is poorly drained. The best control is sanitation and sterilization of the growth media.

3. *Rhizoctonia* leaf blight causes small, irregular necrotic spots that enlarge rapidly and leaf abscission soon occurs. Control by keeping leaves dry.

4. *Botrytis* can be a problem during the cold treatment in dark or poorly ventilated areas. Powdery mildew may also attack the plants under high humidity.

C. Nematodes

1. Several types of nematodes may attack azalea. Symptoms include stunting and yellowing, especially when plants are under stress.

2. Control by removal of infected plants and good sanitation.

D. Physiological

1. Leaf drop caused by under watering, overwatering, poor drainage or nutrient deficiency may occur. It can also occur when plants are exposed to a bright, sunny day after several cool, cloudy days. The cold soil limits water uptake and the plants become water stressed.

2. Delayed or irregular flowering may be caused by late pinching or high temperature during flower development.

3. Vegetative bypass shoots that start to grow below the flower buds and prevent them to open can be controlled by Bonzi applications or removal by hand. The problem is especially pronounced when there is minimal flower induction and development.

4. Defoliation will occur in the cooler when plants are exposed to low ethylene concentrations.

VII. Harvesting, Handling and Marketing

A. Plants should be shipped when buds start to show color.

B. Plants with buds showing color can be held at 10-13°C (50°F) and 12 hours of light a day for 7-10 days.

C. The red colored azaleas may not appear attractive in fluorescent light. A combination of fluorescent and incandescent lights in the display area will show the colors better.

D. The plants should be kept moist in the home and preferably placed in a well-lighted place without drafts.

VIII. Scheduling

Date	Growing Time For Cultural Procedure	Cultural Procedure	Temperature
About 1 year prior to shipping liners		Propagate Cutting	16-19°C (60-65°F)
	6-10 weeks	| V	
		Transplant to flat	18°C (65°F)
	6-10 weeks	| V	
		First Pinch	18°C (65°F)
	6-10 weeks	| V	
		Transplant and second pinch	18°C (65°F)
	6-10 weeks	| V	
		Third Pinch	18°C (65°F)
	6-10 weeks	| V	
May 15		Liners shipped to growers	18°C (65°F)
	2 weeks	| V	
June 1		Pinch	18°C (65°F)
	4-6 weeks	| V	
July 15		Apply B-9	18°C (65°F)
	1 week	| V	
July 21		Second B-9 application	18°C (65°F)
	4 weeks	| V	
August 15		Start Short Days	18°C (65°F)
	5 weeks	| V	
September 25		Start Cold Treatment	7-10°C (45-50°F)
	6 weeks	| V	
November 1		Move to greenhouse and force*	18°C (65°F)
	4-6 weeks	| V	
December 15		Flower	

* For later forcing, the start of the cooling treatment can be delayed or the cooling treatment duration can be increased.