intermediate, and 3 had very heavy crops. There was no correlation between the amount of crop in each orchard for the 1st and 2nd years. Furthermore, initial set counts in 6 of these same orchards the 3rd year indicated a very heavy crop in all cases.

If erratic fruitfulness were due to differences in genetic strains, as suggested by Gourley and Howlett (6), then one would expect to see consistently low production in some orchards and regularly high production in others, which we found not to be the case. Cropping behavior for test orchards was irregular and unpredictable.

Suggestions (8, 13, 21) that bees be placed in prune orchards to obtain commercial crops appear not to be supported by published data. Results of our caging experiments with 'Italian' were inconclusive due to lack of replications and the high set throughout the orchard. However, if inadequate pollen transfer contributes to poor fruit set, supplemental pollination should have increased set in at least some of the test orchards, none of which had introduced bees.

Our conclusions from this study and from the literature are that: 1) 'Italian' prune is fully self-fruitful and does not need pollinizer trees for optimum crops, and 2) bees are not necessary for distribution of pollen.

Literature Cited
17. Schandler, H. 1932. (Pollination experiments in western Germany.) Gartenbauwisc. 6:196-239. [from Knight, R. L. 1969. Ref. 3]

Response of Azaleas to Precisely Controlled Temperatures

Roy A. Larson and Richard L. Biamonte
North Carolina State University, Raleigh

Abstract. Vegetative growth, flower bud initiation, and early flower development of 'Red American Beauty' azaleas were enhanced at temp of 30-26°, 26-22°, 30-22°, 26-18°, and 22-18°C. Earliest flowering occurred following temp of 22-18°, 22-14°, and 18-14°C. The 4°C difference between day and night temp resulted in plants superior in quality to those exposed to an 8° difference.

Most studies of temp effects on vegetative growth and flower bud initiation and development of azaleas (Rhododendron cv.) have been conducted in greenhouses where night temp was principally controlled. The degree of control was influenced by the season of the year and the precision of the heating or cooling systems. Research such as that by Skinner (10), Post (8), Stuart (12), and growers' experiences are responsible for the recommendations of environmental conditions to which azalea plants now are subjected commercially. Year-around flowering, originating at Furrows Nursery in Guthrie, Oklahoma and enhanced by research of Lindstrom (4) and a national cooperative study (11), required more accurate environmental control than for "natural season" production. Subsequent research in growth chambers by workers such as Pettersen and Kristoffersen (6, 7), and Shanks and Link (9) supplied valuable additional information.

The Southeastern Plant Environment Laboratories (Phytotron) (3), with accurate temp control and lighting from a balanced light source was used to study the response of azaleas to controlled temp.

Materials and Methods

'Red American Beauty' azalea plants were used in the experiments. In the first experiment, 5-month-old plants were pruned to 2 shoots, pinched at the start of temp treatments and then pruned to 2 breaks per shoot, a total of 4 per plant. In the
second, 9-month-old plants were used with approx 15 to 20 shoots each. The potting medium was Jiffy-Mix, and the plants were watered and fertilized daily with a modified Hoagland's solution (3).

The growth chambers provided a light intensity of about 4500 ft-c, 2/3's of the wattage from “cool white” fluorescent lamps and 1/3 from incandescent lights (3). The plants were grown under a 16-hr daylength for 6 weeks following the final pinch. Short days (9-hr) were then given for the balance of the experiment.

The temp treatments in the first experiment were begun at the time of the final pinch. They were 26 day-22 night, 22-18 and 18-14, and were maintained for 12 weeks. Then the plants were moved to 10° for 6 weeks under a 12-hr daylength to break flower bud dormancy and were then forced at 12-16°C. In the second experiment, treatments were begun at the start of short days and combinations used were 30-26, 26-22, 22-18, 18-14, 30-22, 26-18, and 22-14. The dormancy-breaking and forcing temp were the same as described for the first experiment. The temp controls were accurate within ±0.5°C.

There were 8 plants per treatment in the first experiment and 32 in the second. Shoot apices were removed biweekly and dissected to determine stage of flower bud initiation or development as proposed by Kohl and Sciaroni (2). Length and diam of flower buds, node number, length of shoots, percent of shoots in flower, number of flowers per inflorescence, and number of axillary or lateral shoots formed (by-pass shoots) were recorded. Plant quality was assessed a numerical value with 10 indicating excellent and 1 denoting poor quality.

**Results**

*Experiment 1.* Lateral shoots developed rapidly at temp of 26-22 and 22-18 but were delayed at 18-14 (Fig. 1). Plants at 18-14 had smaller shoot apices and flower initiation was delayed. Sixteen weeks from the date of pinch, shoot apices from all treatments were at stage 8 (ovules well developed) and of approx the same size. The plants at 18-14 were the first to reach stages 9 and 10 (buds showing color and first flower open, respectively); those at 22-18 were the last to reach either stage. Plants exposed to 18-14 had 0.5 more flowers per shoot and 2 fewer vegetative by-passing shoots surrounding each flower cluster than the other treatments (Fig. 2). The accelerated flower bud development at 18-14 resulted in flowers which were not typically “hose-in-hose” and not all flower parts were fully developed (1). Node number and shoot length were similar in the 3 treatments.

*Experiment 2.* All dissected shoots were vegetative (Stage 0) at the start of the temp treatments. The transition from vegetative to reproductive stages occurred in the apices most rapidly at 30-26, 26-22, and 22-18. Temperature did not cause a marked effect on subsequent bud development, based on flower stages, bud diam or bud length, until after plants were removed from the 10° dormancy-breaking temp. Plants subjected to 22-18 and 18-14 were in flower before plants in the other treatments (Fig. 3). Plants at 22-18 had the highest percentage of shoots in flower (96%), the most flowers per cluster (2.5) and the highest plant quality (9.4) (Table 1).

**Discussion**

Pettersen (5) recommended a minimum night temp of 21° for 12 weeks after the final pinch based on his work with 'Red Wing' and 'Ambrosius'. It was considered better than temp of 12, 15, 18, or 27 for growth and flowering. In another study, Pettersen and Kristoffersen (6) obtained the most rapid flower bud initiation and development on 'Red Wing' at 18°. Flowers were formed eventually at 12 and 15° but flowering was delayed and incomplete flower development occurred at 15°. Similar incomplete development occurred in these experiments at 18-14.

Constant temp were used in the Norwegian studies (5, 6, 7). This study consisted of 4 or 8° day and night differentials. In almost all treatments the plants subjected to a 4° differential were superior in quality to those with 8°. Azaleas produced
under these different temp showed variable habits of growth and flowering similar to those in different geographical areas of the United States. Those at 18-14 were similar in appearance to plants grown in northern California where the summer temp are approx 16 day-10 night, a differential of 6°. Mobile, Alabama and Orlando, Florida have summer temp of approx 34-24°, and the vegetative and reproductive responses are similar to those obtained at 30-26 and 30-22° in the Phytotron. Lateral shoots develop quickly and elongate after the pinch, and flower buds initiate readily. Further development is delayed, however, and bypassing vegetative shoots will develop unless the plants are moved to a cooler temp. Plants grown in the Phytotron at 26-22 or 26-18° are similar to those grown in North Carolina and Virginia. The latter have longer shoots than those in the warmer areas, such as northern California, where lateral shoots are slower to initiate and develop.

Stuart (12) advocated a 16° night temp in the greenhouse with a maximum day temp of 27° or lower. Those conditions would be similar to the 26-18° treatment in this experiment which produced satisfactory plants with a quality rating of 7.5. A final pinch in early summer is required for “natural season” flowering of azaleas. This schedule allows sufficient time for vegetative shoots to develop at high temp which promote flower bud initiation and early development. The plants have well developed flower buds by late autumn, when temp in many areas are cool enough to break flower bud dormancy. Such a long delay from pinch to cool temp treatment, however, has a negative effect on time of anthesis. The percent of shoots that will flower and the number of flowers in each cluster are less than on plants subjected to lower temp. The number of vegetative by-bassing shoots surrounding the flower buds also is increased.

Factors contributing to the success with year-around flowering of azaleas are the relatively short period of time from pinching to forcing, easier attainment of optimum temp for anthesis during much of the year, and use of photoperiod control to accelerate vegetative growth and to promote flowering.

These experiments, conducted at precisely controlled temp, confirmed several of the findings of previous research conducted under greenhouse conditions. The optimum temp for lateral shoot development, flower bud initiation and early development were clearly separated from the optimum temp for subsequent flower bud development. A logical sequel to these experiments would be a study in which temp are changed at different stages of development, from time of final pinch to anthesis, to obtain the highest quality plants in a minimum period of time.

<table>
<thead>
<tr>
<th>Temp</th>
<th>% of shoots in flower</th>
<th>Avg no. of by-pass shoots per plant</th>
<th>No. of flowers/inflorescence</th>
<th>Quality²</th>
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</thead>
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<tr>
<td>30-26°C</td>
<td>74</td>
<td>12</td>
<td>1.6</td>
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<tr>
<td>26-22</td>
<td>91</td>
<td>5</td>
<td>2.2</td>
<td>8.1</td>
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<td>22-18</td>
<td>96</td>
<td>7</td>
<td>2.5</td>
<td>9.4</td>
</tr>
<tr>
<td>18-24</td>
<td>81</td>
<td>3</td>
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</tr>
<tr>
<td>30-22</td>
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<td>7</td>
<td>1.9</td>
<td>6.0</td>
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<tr>
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<td>77</td>
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</tr>
<tr>
<td>22-14</td>
<td>86</td>
<td>3</td>
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<tr>
<td>LSD .05</td>
<td>20</td>
<td>5</td>
<td>0.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

²Quality rating, 10 is excellent.

Table 1. The response of 'Red American Beauty' azalea plants to 7 temp combinations (Expt. 2).

Fig. 3. 'Red American Beauty' azalea plants exposed to 7 temp combinations 6 weeks after pinching.

Literature Cited
