Flowers and Foliage: 75 Years of Papers Published by ASHS

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The origin of floriculture as a commercial enterprise arose from the practices developed by private estates and public parks. The motivation for excellence in crop production was for spectacular display effect at any cost. Fancy greenhouse structures were designed for growing plants which required labor-intensive techniques to bring flowering plants to the desired time of display. Secrets of growing were hoarded by growers. This was unlike the origin and the attitudes of other areas of agriculture. Field and fruit crop production evolved from a subsistence enterprise through barter or exchange to specialization and technological change. The nature of the origin of commercial floriculture was further handicapped in that its perishable products implied a limited need for duration.

The application of technology and its dispersal to all interested persons was one of the major reasons for the founding of the American Society for Horticultural Science. For almost the first 25 years of its existence, however, the technological information which was changing pomiculture and olericulture went unreported for floricultural plants. These conflicting viewpoints have continued. Our problem, even today, is how to put a science into a research area whose final use becomes an "art"? The additional, often undefined and almost undocumentable aspects of environmental participation of decorative plants continues to baffle floricultural scientists. One only has to mention the debate over the removal of gift plants from a hospital room to see the conflicting forces at play in seeking recognition for floricultural science.

Research findings must be documented by the act of publication in journals such as those of the ASHS. Many of the achievements went directly from observation to practice (and repractice until perfected). Many of the connecting steps were lost from literature. A strong oral method was practiced, particularly through the device of the growers short courses. The literature as published by ASHS is far from complete. The 103 volumes revealed only a small part of the information which has been discovered. Handbooks, grower manuals, and catalogs still conveyed much of the information used to grow floricultural plants.

What do we find that points to the major trends and achievements of the past 75 years and what do they suggest that the researcher should be doing in the years ahead?

Temperature

Regulation of plant growth began with the selection of the day-night temperatures. The recurring word utilized to explain what was being done to the plant was "force." Its meaning implied that something, either the flower buds or stimulus, had already been formed at some (leisurely) rate in the past. All that had to be done was to warm the plants up to bring them into flower ahead of their traditional time of flowering. Spring and summer flowering bulbs, deciduous and evergreen shrubs, and winter flowering annuals fitted into this framework of growing. The early literature centered on changes in temperature in relationship to the time of year. The point was to get the plants into flower, regardless of the quality of the flowers or their longevity.

Until central heating and refrigeration were widely introduced into living spaces in the 1930's, the whole point was to have the flowers for a particular moment at any price or quality. As the temperatures in living spaces began to creep up, many traditional crops, such as sweet peas, cinerarias, and cyclamens, did not survive. Growers began to seek alternative crops which would do well in the warm environments. It was at this time that the classic temperatures for most of our floricultural crops were standardized: stocks (70), hydrangeas (1), carnation (38, 87), azaleas (72, 81), gardenia (25), rose (46, 62), gladiolus (77), tulip (34), snapdragon (56, 60) fuchsia (78), and daylily (2).

The culture of other plants required detailed temperature studies at every stage of their development to produce consistent crops. To look back now, one would wonder how Easter lilies and chrysanthemums were even brought to flower before the 1960's. The key words in the history of flowering Easter lilies were development (29), forcing (45, 85), cooling (69), vernalization (61), and high temperatures (28). The Easter lily thus can be stored as a bulb, brought to flower any time of year, brought to flower with only partial completion of its vernalization requirement, and can be devernalized into a rosette of leaves. The progress with chrysanthemum can also be identified through the years by the key words: flower bud formation, flowering in tropics (64), flower development (32), thermal induction (13), cutting age (31), flower initiation (14), cold resistance (95), and seed production (54).

Light

The growing structures for year round flowering were derived from the estate greenhouses which were large and tall, connected to central corridors. The design thus provided adequate ventilation between the houses. All work surfaces were covered with concrete or similar materials. The growing areas were raised beds or ground beds. The work space took up to 40% of the growing areas. The greenhouses were oriented North-South to capture the daily rotation of the sun. The covering was glass. Pipers, supports, and braces obscured the exposure of plants to the sun. To avoid the "so-called" greenhouse effect during the summer months, thick layers of shading compound were applied to the glass. Each spring it was painted on; each fall it was washed off. Side and top ventilators provided a natural circulation of warm and cool air. The dense covering and high temperatures were unfavorable to the growth of the many plants. Saran covered structures were used as the alternative structure for growing summer crops (52). The cotton mesh reduced the light intensity but permitted rapid air movement, particularly for structures located in the mountains or northern regions of the U.S. Quality flowers were produced year round; part of the year under glass, part of the year under saran.

Manipulation of the daylength and its use for changing flowering time began with Laurie (51), Poesch (68) and Post (73). Many aspects had to be considered for each crop; artificial light source, intensity and duration (each night) of the artificial light source, time to start and end yearly lighting cycle, black cloth to reduce the daylength, optimum temperature and age of plant for photo-regulation, and identification of cultivars suitable for use in year-round flowering programs. We have continued to perfect the techniques of photoregulation through the selection of black cloth (51), light cycle (16, 43), light duration (84) and light source for daylength control (27, 66, 96).

Through the years, daylength responses have been reported for sweet peas (40), comos (6), china aster (6), annuals (74), poinsettia (35, 49, 71), gardenia (59), orchid (42), greenhouse violets (24), tuberous begonia (53), hydrangea (67), carnation (93), petunia (66), fuchsia (78), and lily (92). Fifty-eight years after the discovery of the importance of daylength by Garner and Allard, many crops have not been evaluated as to their response to daylength.

Manipulation of the light during or as a substitute for the natural daylight was not considered a researchable problem. The assumption was made that the light intensity required for the field culture of plants was also required under enclosed environments. The relatively dim and hot incandescent lamp was not a satisfactory light source for growing plants. Fluorescent lamps were introduced in the early 1930's, not so much for efficiency as for uniform lighting levels in low ceiling rooms. Intensities of 150 to 300 foot candles (1.6-3.2 klx) of light were used in basement rooms to root and graft plants under a consistent light and temperature controlled environment (83). The benefits of supplemental lighting has been demonstrated on a range of floricultural crops, including rose (10, 75, 94), chrysanthemum (86), saintpaulia (39, 82), snapdragon (30), lily (47), and gernaium (36).

Lighting to control the photoperiodic responses has been standardized to the use of incandescent lamps, at 100 to 200 lux, given continuously or intermittently in the middle of the long light for at least 4 hours (16, 22). The lighting to supplement sunlight, even with the years of research, is far from standardized. Even today we do not know the light compensation points, the light required for growth under living-room conditions, and the light intensities and qualities which regulate growth and produce plants typical of those grown out-of-doors. The equipment to attain efficient photosynthetic activity of plants – lamps, luminaires, ballasts, reflectors, thermal blankets – are only becoming available for use by experimentors.

Growth substances

Testing of growth regulating substances has gone through many fads. Unlike the research with light, which was restricted to detailed work on a few species, growth substances were useful on a wide range of plant materials. The sequence of events are familiar:

- Rooting cuttings (23, 41, 55);
- Weed control (48);
- Growth inhibition (4, 5, 58, 76, 88);
- Gibberellins, growth acceleration and early flowering (3, 7, 8, 21, 50, 78);
- Chemical defoliation (44);
- Growth retardants (9, 19, 37, 57, 90);
- Chemical protection against stress (17, 18, 20);
- Kinetin (33, 79);
- Ethylene (65, 89);
- Chemical pruning: (11, 12, 80, 97);
- Chemical disbudding (15);

The kinds of chemicals tested, their analogs, formulations and carriers, methods of application, and interactions with the environment involved an infinite number of combinations. Out of these trials have come two major uses on a wide range of florist crops (26, 63):

Indolebutyric acid for rooting cuttings. IBA is diluted in talc or alcohol/water to give various concentrations for easy-to-root herbaceous cuttings to difficult-to-root woody plants. Even today, we are still discovering new substances, co-factors, and techniques to root cuttings.

Chemical growth retardants for compact growth. The first chemical was a nicotinium compound and was effective only on snapbeans. Through the years, 6 chemical families, (each with many active analogs) have been found to exert these effects on an ever increasing number of plant species. Only a few woody and tropical species were non-responsive. The side effects of the chemicals were as important to the user as were the visual changes of compact growth and deep green foliage to the grower. Growth retardants also indirectly affected flowering without causing malformation of the plant, increased rooting of cuttings, promoted formation of yellow pigments in flowers, and reduced visible injury caused by the air pollutants ozone and sulfur dioxide.

Two areas where we have made little progress are in discovering chemicals which counteract the aging effects of ethylene and related pollutants and/or in the promotion of flowering. These two systems were apparently tied together in bromeliads. Ethylene, however, caused rapid degreening, maturation, defoliation, and senescence of most flowering plants (65). Unlike the fruit and vegetable research areas, there were few reports on chemicals which reduced ethylene production in florist plants. Analogs of rhizobitoxine (91) apparently modified ethylene action and extended the longevity of cut carnations and snapdragons.

Current viewpoints

The emphasis and viewpoints of the papers since Volume 100 reflect the changes which are radically remolding the florist industry. These changes are:

- Expansion of the list of researchable plants to more than 1000 species.
- Development of information concerned with the biochemical basis for the keeping quality of plants.
- Return to the uses of plants as herbals, sources of naturally produced compounds, and natural landscaping.
- Loss of the distinction between cut flower and container plants, florist and nursery plants.
- Emphasis on speed in producing plants which will thrive under the conditions found in living spaces.

Future viewpoints

The researchable areas in the future will require many skills from allied fields to accomplish the following:

Energy-conserving production facilities. All growing areas must be located near sources of excess industrial or natural heat. The alternative sources based on fuels will soon be too expensive for use by plant producers. All aspects, including greenhouse design, location, and crops produced, will change.

Labor-conserving production facilities. Many of the steps in handling the crops require highly-repetitive, labor-intensive care. Many steps, such as pinching, disbudding, cutting stems, leaf removal, require individual treatment, plant by plant.

Long lasting plants. We must treat cut flowers and container plants with a similar viewpoint. The ultimate performance of the plant material under conditions of actual use should determine practices. There must be simpler and more effective ways to grow our plants.

Alternative marketing forms. Many of our products have been stereotyped into a 10-cm flower or grown in a 10-cm container, regardless of the ultimate use. Tissue culture techniques and substitutes for growing media and containers should open up the opportunity for the marketing plants and plant parts of an ever increasing range of species.

The review of the past 75 years reveals that we have acquired many tools to control the growth and development of a wide range of florist and nursery plants. For all of the ones on which we have lavished detailed work, there are hundreds more than require our skills to make them successful; to be produced by growers and to be enjoyed by consumers. Our assigned research opportunities should be obvious to all.

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