INTRODUCTION TO THE SYMPOSIUM

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Because of new developments and sustained interest in chemical regulation of plant processes, it was considered appropriate to make this field the subject of a major symposium for the 1968 annual meetings of the Society. The primary purpose of the symposium was to present an up-to-date understanding of chemical regulation of plant processes. The choice of topics and speakers was made with the help of a number of active investigators in the field.

Dr. Anton Lang, Director, Plant Research Laboratory, Michigan State University, East Lansing, introduced the subject at a preliminary session. The four papers presented here cover the following topics: vegetative and reproductive development; fruit-set and development; fruit ripening; and finally, ageing, senescence and abscission.

In the 40 years since Fritz Went's discovery of an objective biological assay for auxin, "cradle-to-the-grave" chemical regulation has rapidly become an important aspect of food supply and quality. What commenced as a basic study relating to the control of coleoptile curvature has developed into a major field. This field has evolved along two interrelated lines: (1) research concerning the nature of hormonal control of plant processes, and (2) the application of this knowledge to the solution of practical problems.

Went's discovery was followed by characterization of at least four other classes of plant growth hormones: gibberellins, cytokinins, abscisic acid(s) and ethylene. Many other compounds with a variety of physiological and pharmacological effects have been produced. Some are in practical commercial use. Moreover, out of this research have come new insights into hormonal regulation of such diverse physiological processes as root initiation and development, seed and bud dormancy, vegetative growth and form, flowering, fruit set and development, ripening, abscission and senescence.

Interestingly this knowledge was produced in government, commercial and university laboratories. Major discoveries have been made by both "pure" and "applied" scientists. If there is any lesson to be learned, it is that we do have a continuous feedback of information from both disciplinary and mission-oriented research, which together, contribute to solutions of both practical and theoretical problems.

CONTROL OF VEGETATIVE AND REPRODUCTIVE DEVELOPMENT IN SEED PLANTS[1]

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Although for an entire plant, vegetative and reproductive development may proceed concurrently, at each shoot apical meristem a transition occurs from leaf production to bract or sepal production at the time of flower initiation. Subsequent stages of reproductive development are equally differentiated from that of vegetative development. Hence, vegetative and reproductive development represent alternative courses of differentiation of apical meristematic tissues.

For many years the presumption was that a unique control mechanism existed at the hormonal level for switching from one course to another. Indeed much evidence has been gathered, mainly from studies with many daylength sensitive plants, that one hormone, called florigen, is produced in the leaves and translocated to apical meristematic tissues where it causes floral initiation. How this hormone acts or interacts with other systems controlling plant development remains a mystery. The chemical nature of florigen is unknown. Some degree of success with extracts possessing florigen activity has been achieved in two laboratories (9, 38), but sufficient quantities of such extracts have never been available for extensive physiological tests. Nevertheless, the supposition is that it is a universal hormone which in some fashion controls floral initiation, and perhaps some stages of development, in all seed plants (9, 37, 53).

Our purpose is not to review the florigen concept, but rather to summarize the literature concerning the control of reproductive development by known substances. The title of this article reflects the fact that, without exception, the flower promoting or inhibiting substances available can also have great effects upon vegetative development. Since we wish to emphasize the interaction of several physical and chemical factors in the control of vegetative and reproductive development for the entire plant, we have not analyzed these morphogenetic events into their component processes.

Promotion of flower initiation by gibberellic acid is now well-known for many long day-requiring rosette plants as well as for some caulescent species (37). There is good evidence, too, that endogenous gibberellin levels increase in long day conditions prior to bolting and flower initiation. How the gibberellins act as flower-inducing substances is not known, but there are some interesting facts that suggest a separate role for gibberellins in the control of vegetative and reproductive development. Michniewcz and Lang (40) were able to demonstrate that some of the gibberellins were more effective in promoting flower initiation. Furthermore, Baldev and Lang (3) Have shown by the use of growth retardants that the level of gibberellic acid, or native gibberellin, required to promote flower initiation is less than that required for bolting. Earlier Zeevaart and Lang (63, 64) suggested that in *Bryophyllum diagremontianum*, a long/short day plant, this minimal level of GA was achieved during long day induction and thus permitted the subsequent synthesis of florigen in the leaves in short days. In view of the recent findings of Stoddart and Lang (57) which are discussed below, it is possible that the applied GA is converted to another type of gibberellin which is a flower promoter.

There are other substances which promote flowering in rosette plants (41, 42) and some which increase numbers of flowers per cluster (59) but their effects are less well-known than those of GA.

Although the major emphasis in the literature appears to be on gibberellin-induced promotion of reproductive development, there is abundant evidence that gibberellins also inhibit floral initiation and development. In *Pharbitis*, Zeevaart (62) found that in long day conditions CCC, a growth retardant which apparently inhibits gibberellin synthesis promoted flower initiation, whereas in short day condition it inhibited flower initiation. He suggested that there was a maximum level of gibberellin above which floral initiation could not occur. This was exceeded in long day and not achieved in short day conditions. CCC lowered the gibberellin level to the proper range in long days and depressed the level below optimal in short days. The maximum level has not been determined for *Pharbitis* nor for any other species. In *Pisum* (4, 43, 55), *Kalanchoe* (33), *Fragaria* (61), *Prunus* sp [including peach (8, 16), apricot (8), cherry (8), almond (8)and plum (8)], *Malus* (26), *Pyrus* (24), *Citrus* (44), *Syringa* (15),

[1]The following abbreviations and names are used in this article:

GA - gibberellic acid, gibberellin A_3

CCC or Cycocel - (2-Chloroethyl) trimethyl ammonium chloride, (American Cyanamid Co., Princeton, N. J.)

B - 9 or Alar - 1, 1 dimethylamino succinamic acid, (UniRoyal, Naugatuck, Conn.)

Phosphon - 2, 4 dichlorobenzyl tributyl phosphonium chloride (Mobile Chemical Co., Ashland, Virginia)

Amo - 1618 - 4 - hydroxyl - 5 - isopropyl - 2 methylphenyl trimethyl ammonium chloride 1 - piperidine carboxylate

BOH - beta - hydroxyethyl hydrazine

Ethrel - 2 - chloroethyl phosphonic acid (Amchem, Ambler, Pa.)

TIBA - 2, 3, 5 tri-iodobenzoic acid