H I S T O R Y

Botanists first became acquainted with growth-regulating substances through their studies on tropisms. Notwithstanding the observations made by Duhamel Du Monceu (1758), Julius Sachs (1880, 1882, 1893), and Beijerinck (1888-1897), Charles Darwin is generally credited with the earliest research on growth regulators in plants (81).

It all started when he began to wonder why plants turned towards light. His main concern was the elucidation of the mechanism of tropisms. He chose the seedling of the ornamental canary grass (Phalaris canariensis L.) as his experimental plant. Grass seedlings are known to produce, on germination, a tubular first leaf called a coleoptile which is particularly sensitive to light stimuli. Darwin observed that when the coleoptile was illuminated from one side it bent over towards the source of light, but the region in which the bending took place was far removed from the tip of the coleoptile. If the extreme tip of the coleoptile were removed or covered by a small cap of light-proof material, such as tin foil, no bending took place in the lower region on subsequent exposure to light.

Localised sensitivity to light and conduction of a stimulus were also observed in the hypocotyls of cabbage (Brassica oleracea L.) and beetroot (Beta vulgaris L.).

From his experiments Darwin postulated that the light was perceived by the tip, and concluded "that when seedlings are freely exposed to a lateral light, some influence is transmitted from the upper to the lower part, causing the latter to bend" (20).

In 1911, Boysen Jensen (15) suggested, after working with oat seedlings (Avena sativa L.), that a purely chemical mechanism was accountable for this transfer of stimulus or "influence". This was confirmed when it was shown that the "influence" would

pass through non-living tissue such as gelatine. This was the first evidence that plants contain something that acts like hormones. It was not until 1926 that this chemical messenger was finally isolated by Went (90). It was this isolation and the biological assay method that developed from it that truly mark the beginning of the modern era of plant growth-regulating substances.

Although by 1910 the idea of hormones was well established in animal physiology, its development in plants was much slower. Research on plant hormones received an impetus in 1928 when Went's classic paper "Wuchsstoff und Wachstum" (91) appeared. In that treatise the author described the now famous quantitative method of using oat seedlings for assaying plant hormones. Went's original assay method has undergone numerous refinements since then, but the basic principle remains the same.

By 1931, Kögl and Haagen-Smit (51) discovered a substance in human urine which they called "auxin", implying growth and cell elongation in the name. Other substances, including a "heteroauxin", were found later. However, the study of synthetic plant growth-regulating substances may be said to have started in 1933 when Kögl, Haagen-Smit, and Erxleben (52) showed that 3-indoleacetic acid could promote cell elongation in plants, although it was Zimmerman and Wilcoxon (98) who discovered several chemical growth substances in 1935 that could initiate rooting and other responses in plants.

Shortly after the identification of indoleacetic acid in 1933, Thimann and Koepfli (79) showed that it could induce rooting in stems. Zimmerman and Hitchcock (99) confirmed this finding a little later. Cooper (19) was the first to demonstrate the successful use of indoleacetic acid in lanolin paste to stimulate the rooting of cuttings.

The economic importance of this new discovery was realised

almost immediately. In plant propagation 3-indoleacetic acid was used to induce the rooting of cuttings. Many other known chemicals were also tested, and new compounds were synthesized for trial. In the words of Avery et al (12), "the few years subsequent to 1935 might well be called the 'smear era', in which synthetically produced hormones were applied to numerous kinds of plants with a wide range of objectives". It is of interest to note that whereas in 1930 only 50 papers relating to plant growth-regulating substances were published (70), the number had increased to nearly 5,000 for the period 1934-1937 alone.

The rooting of cuttings was only the beginning of the new discoveries and their application to practical problems. It was only a matter of time before new chemicals were employed in "the prevention of preharvest drop of fruits, increase in fruit set, production of seedless fruits, prolongation of dormancy in nursery stock, delay in blossoming of fruit trees, improvement in regulation of flowering in pineapple, defoliation, thinning of fruit, hastening of fruit maturity, hastening the colouring of fruit, reducing water loss in fresh vegetables, ripening fruit artificially, and destruction of weeds and undesired woody plants" (83).