Production of Auxin by Detached Leaves

IN senescent leaves proteins are hydrolysed to amino-acids and peptides[1], which might be expected to release protein-bound auxin and also to provide considerable amounts of tryptophan which can be converted by many plant tissues to the auxin indolyl-3-acetic acid (IAA). We have therefore investigated the concentrations of auxin in senescent leaves.

Mature trifoliate leaves from plants of *Phaseolus vulgaris* and leaves from young plants (2–3 weeks old) of *Avena sativa* were detached and placed with their petioles or bases in distilled water in the dark at 25° C. In these conditions, the leaves become senescent and turn yellow. Samples were taken at various times (at intervals of 1 or 2 days), weighed and stored in the deep freeze until they were extracted with peroxide-free ether for 3 h at 0° C. The ether extract was partitioned and the acidic fraction was run on paper chromatograms with isopropanol : ammonia : water (8 : 2 : 1 v/v). The zone corresponding to IAA was eluted and the auxin was estimated using an *Avena* coleoptile straight growth bioassay. The amounts of auxin extracted from the leaves at various times are shown in Figs. 1 and 2.

It can be seen that in both cases there is a large increase in the amount of auxin present over a period of 6 days. The amounts measured represent the resultant of auxin production and auxin destruction: in the case of *Avena*, after about the fourth day the rate of destruction exceeds the rate of production. The fall in total auxin was observed in each of six experiments. Libbert *et al.*[2] maintain that most of the IAA which can be extracted from plants is formed by epiphytic bacteria, but because plants do not normally grow in sterile conditions this alleged bacterial production of IAA is likely to be very significant physiologically. Thus although the experiments reported here were not performed in sterile conditions, the results are relevant whether or not the auxin is formed in part by epiphytic bacteria.

Young expanding leaves are an important source of auxin in the plant and concentrations of auxin in mature leaves are low[3–5]. The concentrations of auxin in attached senescent leaves, however, have received little attention, and such measurements as have been made have been based on relatively infrequent sampling (usually at intervals of about 10 days). A peak of auxin production during leaf senescence could therefore have been missed. The level of auxin in leaves and petioles is involved in the control of abscission[6] so the production of auxin by senescent leaves, if it is a general phenomenon, may be an important factor which so far has been overlooked.

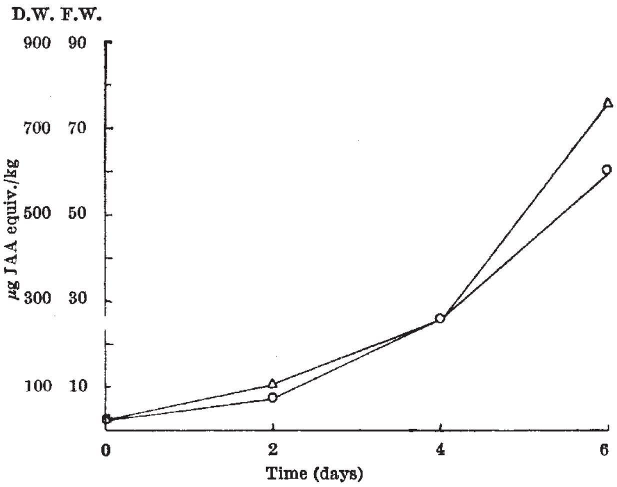

Fig. 1. Auxin levels in detached *Phaseolus vulgaris* leaves. Expressed on dry weight (D.W., ○) and fresh weight (F.W., △) basis.

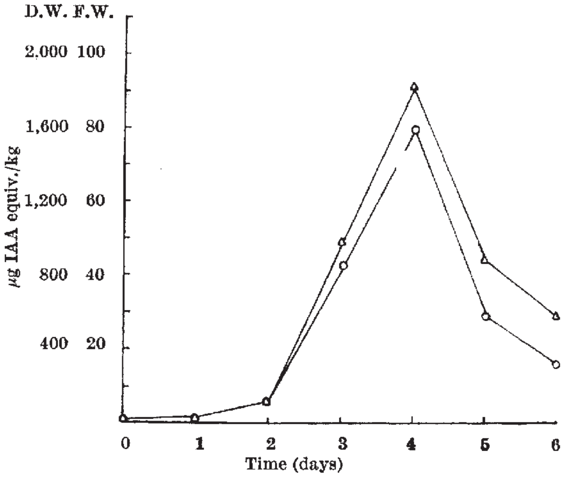

Fig. 2. Auxin levels in detached *Avena* leaves. Expressed on dry weight and fresh weight basis as in Fig. 1.

We have suggested elsewhere[7] that dying cells are a principal source of auxin in the plant. Because cell death is frequent in normal growth, differentiation and development of the plant, the production of auxin by senescent, dying leaves may be only one example of a much more general process.

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GENERAL

"Least-squares" Estimation of Distribution Mixtures

THE statistical estimation of the unknown fractions Π_i ($i=1, \ldots k$), and, when unknown, further parameters $\theta_j (j=1, \ldots m)$, in a mixed population which is denoted by its cumulative distribution (taken to be univariate)

$$F(x) = \sum_{i=1}^{k} \Pi_i F_i(x)$$

is, in general, cumbersome. It therefore seems worth noting the convenience and comparative efficiency, at least in relation to the estimation of the Π , of estimators of "least-squares" type, defined by the minimization of the integral

$$\int (\mathrm{d}F_s - \mathrm{d}F)^2/\mathrm{d}G$$

where $F_s(x)$ denotes the cumulative distribution of the empirical sample (from, for example, n independent observations), and $G(x)$ is a suitable increasing function of x. Taking for simplicity the case $m=0$, the estimators of the Π_i are automatically unbiased with exact variances readily calculable, and with asymptotic normality. For example, if $k=2$, we have an estimate p_1 for Π_1,

$$p_1 = \frac{\int (\mathrm{d}F_s - \mathrm{d}F_2)H}{\int (\mathrm{d}F_1 - \mathrm{d}F_2)H}$$