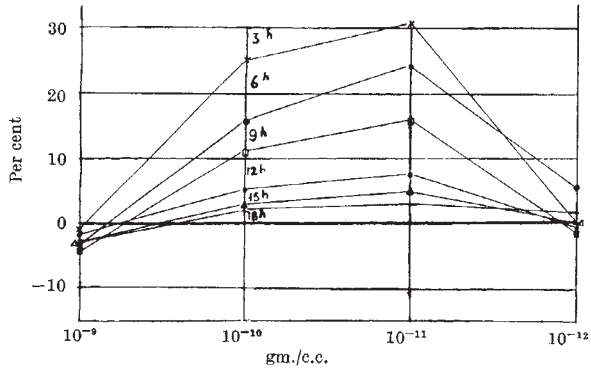
Sensitivity of Cress Roots to Indole-Acetic Acid

IN 1939, Thimann[1] recorded in a discussion on the growth of roots: "The amount of auxin normally in these roots is not far from the optimum for their growth, so that further addition could be expected to accelerate growth only slightly". A marked increase in the root growth induced by indole-acetic acid should be obtained only if the supply of the acid in the root is less than the optimum; thus distinct increases have been produced with decapitated roots depleted of their own source of indole-acetic acid[2]. However, experiments with *Lepidium sativum*[3], *Linum usitatissimum*[4] and *Artemisia absinthium*[5] have shown that it is possible to accelerate the root-growth of germinating seeds.

We found that the roots of germinating cress seeds have no constant growth-rate in spite of constant conditions. The measurements began 24 hr. after sowing. At intervals of 3 hr. the lengths of the roots were measured. At first the growth-rate increases to a maximum, then it decreases. The root of a cress seedling passes through three phases of growth: (1) at the beginning of germination a phase with a low growth-rate; (2) a phase of maximum growth-rate; (3) a phase of decreasing growth-rate. We were able to demonstrate by the determination of the indole-acetic acid content in roots of the second phase (5–6 mm. long) and of the third phase (20–25 mm. long) that the concentration of the acid in the short roots is about double that of the long roots. The amount of indole-acetic acid available to the roots determines the growth-rate. An acceleration of the growth-rate (about 15–20 per cent) was obtained with cress seedlings of the harvest 1944 and 1947, if the measurements were carried out in the third phase. The cress roots are sensitive to indole-acetic acid if their growth-rate is less than optimal.

The difference in duration of the first and second phases is evidently connected with the amount of indole-acetic acid in the seeds. We showed[6] that the amount of the acid contained in cress seeds of different years of harvest and of the same seedsman (H. Hild, Marbach, Germany) may be different: seeds of the year 1950 contain about ten times as much indole-acetic acid as seeds of the year 1947. The third phase is reached early with seeds of 1944 and 1947, late with seeds of 1949 and 1950.

The accompanying diagram shows the result of an experiment carried out with cress harvested in 1949,



Lepidium sativum (harvest, 1949). Percentage increase (+) and inhibition (−) of the growth of roots in comparison with control (o–o- line) at various concentrations of indole-acetic acid and various treatment times

in which the effect of immersing the roots in indole-acetic acid for different lengths of time was determined[7]. The greatest increase occurred after a short treatment. As the roots approach their phase of maximum growth-rate, their sensitivity to the acid decreases progressively. If the acid is added to roots in the maximum growth-phase there is no response.

The roots of the cress seedlings which are susceptible to indole-acetic acid must be used either during the first or the third phases, but not during the period of maximum growth-rate (second phase). Even then the concentration of indole-acetic acid must be low, 10^{-10} gm./c.c. or less. Thus before the test is applied, it is necessary to determine the growth-curve of the available seeds.

It is believed that the causes of the low growth-rates in the first and third phases are different. In the first phase, the supply of indole-acetic acid is insufficient, because there is a delay while the reserves in the seeds gradually become available. These processes of activation are very uncertain, and it is rather difficult to bring them under control. Therefore, the results show great variability. In addition, the errors involved in measuring small increments (1–3 mm.) are greater. A real deficiency of indole-acetic acid occurs during the third phase because the reserves in the seeds run low. The seedlings are in the dark, and the normal supply is not established. The response to indole-acetic acid is very uniform, and the measurement of the larger increases (17–22 mm.) can be done more exactly.

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Isolation of a Carbamido Acid from Autolysed Yeast

SAMPLES of baker's yeast that have undergone autolysis in presence of toluene or chloroform give an intense red colour reaction when boiled with diacetyl in hydrochloric acid, which is characteristic of compounds of the type[1] —CH_2—NH—CO—NH_2. Of the natural urea derivatives at present known, citrulline is the only one that gives a red carbamido diacetyl reaction; urea, itself, gives a yellow colour; allantoin and allantoic acid give varying shades of orange-pink, probably due to urea liberated under the conditions of the test; cyclic ureides do not react chromatically. Hence, it was assumed at first that the yeast reaction was due to citrulline, originally present as a unit, or arising from arginine by desimidation.

With the object of identifying the chromogen, the autolysate obtained from 6 lb. of baker's yeast was filtered, diluted and subjected to displacement chromatography on 'Zeo-Karb 215'. The progress of the operation was followed by means of the diacetyl reaction, and the carbamido-rich portion of