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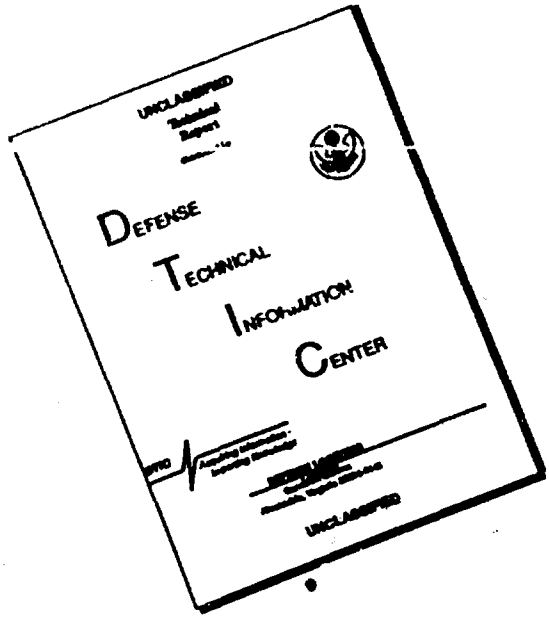

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Gj. 1

On the Physiology of Feeding by the Root-Knot Nematode

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As is well known, the development of galls and giant cells in the roots is the distinguishing feature of the root-knot nematode's effect on a plant. The latter are regarded as trophic agents between the nematode and the plant (4,5). Many authors consider the giant cells a polynuclear coenobium (4). However, one may express another, more probable conception, that the giant cells develop as a result of a multiple cleavage of the nucleus without an accompanying division of the plasma. Two things indicate this: the first is, the accumulation of the nuclei in the very same place as the plasma in the giant cell (2), which is typical for the giant cells; the second is, the lack of nuclein acids in the galls, that in analogous cases also leads to the growth of giant cells (3).

The purpose of our tests was to trace a plant's reactions to the root-knot nematode (Meloidogyne incognita). As a rule, the analyses were histochemically conducted on the roots of cucumbers and tomatoes, and for comparison purposes also on lettuce, begonias, peas, radishes and corn. We investigated the respiration, respiratory ferments, pH, nitrogen exchange and the physiologically active substances. For the investigation they used simple and compound galls (syngalls), strong and decaying galls, and also healthy roots. The respiratory coefficient proved to be: in the roots of healthy cucumbers - 0.8, in strong galls - 0.6, in the decaying ones 0.7. The absorption of oxygen at 1 gram per hour proved to be: in the healthy roots - 0.45, in the strong galls - 1.53, in the decaying galls - 0.51. In order to clarify the causes of the increase in the rate of respiration in the diseased roots of the plants listed above, we conducted investigations of the respiratory ferments. In the places where the galls were formed, peroxidase and cytochromoxidase were accelerated. A polyphenoloxidase was detected in the galls of the radish. The activation of the oxidizing ferments occurred in direct proportion to the degree of gall development. The investigation of acidity gave the following results: the pH of the healthy root in the parenchyma proved to be 4.8 and in the conducting fascicles - 5.2; strong gall - 6.8-7.0; decaying gall - 7.2-8.0. Such a sharp increase of alkalinity, as further tests showed, is caused by the progressive accumulation of ammonia at the points where the nematode is found. The ammonia was detected by the Nessler reagent.

For the study of nitrogen exchange in the galls, we investigate for the presence of SH-groups, amino acids, nuclein acids and protein. The liberation of the sulfhydryl groups indicates a splitting of the protein molecules along the points of the disulfide bridges. In the galls which were treated with acetate of zinc and nitroprusside of sodium, an intensive pigmentation develops near the head end of the females withing the limits of

the giant cells which attests to the presence of SH-groups. The amino acids were detected with ninhydrin. As to the degree of growth in the galls, their numbers were increased. The nuclein acids were investigated with the Unn reagent. The quantity of ribonuclein acid in the parenchyma of the galls is decreased at the points where the nematodes are located and the thymonuclein acid is without changes. Consequently, as a result of the excreta of the nematode, there occurs a breakdown of the protein to the simpler nitrous compounds, with which it is nourished.

The active physiological substances were studied for the purpose of investigating the cause of the galls' growth. A.A. Ustinov (4) suggests that the growth of galls is stipulated by the growth hormones. Went (7) considers that there is no growth without auxin. We made histochemical analyses for heteroauxin. The characteristic pigmentation was not produced. A biological test for auxin was conducted on the coleoptiles of oats and compared with the scale for the different concentrations of heteroauxin. The growth of coleoptiles in the ether extract from galls did not exceed the growth shown in the control (healthy roots). The analyses of toxins were performed by the following method. Aqueous extracts (1:100) were made from the galls and from healthy roots. The extracts were boiled (in order to eliminate ferments), and mungo bean (Phaseolus aureus) sprouts were cultivated in them. The presence of toxins was determined by changes in the growth tempo of the embryo roots. For the first 26 hours, the growth of the embryo roots of the beans in the gall extracts was strongly deferred in comparison with the extracts from healthy roots. However, during the course of the plants' growth the toxic effect of the gall extracts was professed to be less and less and after the passing of 2 days it began to stimulate the growth of the embryo roots. After 5 days the embryo roots in the extract from old galls outstripped the growth of the embryo roots in extracts from healthy roots by approximately 30%, and from water - 150%.

Consequently a gall is formed not as a result of the influence of the basic growth hormones which originate in the plant itself, but either under the influence of the toxins excreted by the nematode or, more preferably, of the products of the interaction of the nematode with the plant. These toxins also change the normal growth processes. It is known (8) that several amino acids stimulate the pathological growth of meristem. It is possible also that the liberation of amino acids by the nematodes is a reason for the growth of galls. The growth of meristem takes place in the plant in the paths of descending currents which carry the products of synthesis. In as much as in the gall the normal growth processes are suspended, then the incoming nutritive substances are not fully utilized by the plant which allows the development of the nematode. On the other hand, the gall may be considered the plant's protective barrier against the action of the nematode.

As a result of its life processes, the root-knot nematode reduces the gall to such a condition (alkalization, accumulation of activity products) that its continued stay in the gall becomes impossible and the larvae abandon the gall (syngall), yielding the place to saprobiotic nematodes. (1, 2)

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