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This Week's Citation Classic

Galston A W & Dalberg L Y. The adaptive formation and physiological significance of indoleacetic acid oxidase. *Amer. J. Bot.* **41**:373-80, 1954. [Kerckhoff Labs. Biology, Calif. Inst. Technology, Pasadena, CA]

As plant cells age, their *in vitro* ability to destroy the plant growth hormone indoleacetic acid (IAA) increases progressively. Such IAA oxidase activity rises in young cells after pretreatment with IAA. This inducible system provides a biochemical explanation for aging and rhythmic growth in plants. [The *SCI*® indicates that this paper has been cited over 160 times since 1961.]

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"It is paradoxical that of all my published papers, this one should have become a *Citation Classic.* I think it is fair to say that it generated lively controversy when published, and continued to produce as much disagreement as acceptance over many years. Even today, some workers are reluctant to accept an *in vivo* regulatory role for IAA oxidase, while agreeing that the enzyme is present and active *in vitro.*

"My early work in plant physiology concerned hormonal control of plant growth patterns. For any hormone to serve as a regulator of growth, it must exist in tissue in rate-limiting concentrations. This implies that a balance must exist between the rate of hormone synthesis on the one hand, and its rates of utilization or destruction on the other. Thus, when Yu-wei Tang and James Bonner[1] reported the existence of an indoleacetic acid (IAA)-destroying enzyme in etiolated peas, my interest in its possible physiological importance was immediately aroused. I had just returned to Caltech after several years in military service and one year at Yale, and it was easy, during the readjustment period, to fall under the charismatic influence of Bonner, whose graduate student Tang had first discovered IAA oxidase.

"My interest in photobiology had led me to discover the riboflavin-sensitized photooxidation of IAA,[2] and I was thus attuned to IAA destruction as a possible physiological control mechanism. In addition, I had become extremely interested in the then emerging subject of inducible enzymes, sparked by a brief visit to the laboratory of Jacques Monod in Paris, and a conversation there with Melvin Cohn. What could be more natural than to work on an inducible, light modulated enzyme system that controlled growth by destroying growth hormone? The fact that the enzyme turned out to be peroxidase-based was an extra attraction, since I had spent a year in Hugo TheorelPs laboratory in Stockholm, studying hydroperoxidases and isolating catalase from spinach leaves. In retrospect, this work must have developed because it so effectively fused several of my most active research interests; I couldn't have chosen the subject randomly.

"In the light of present patterns of scientific support, it is amusing to note that this work was supported by a grant from the American Cancer Society. How much botanical work, I wonder, is being funded today through this source? The grant made possible the hiring of Lotte Dalberg, a laboratory assistant from Israel. We performed together the technically demanding kinetic experiments that led to the idea of enzymatic induction for this system.

"IAA oxidase is greatly affected in its activity by substituted phenols; monophenols tend to be cofactors, interacting with manganous ion, while o- and p-diphenols are strong inhibitors. The fact that the plant pigment phytochrome controls the synthesis and hydroxylation pattern of phenolics and flavonoids[3] helps explain its control of IAA oxidase activity[4] and perhaps also of IAA content of tissue. This connection explains my subsequent fascination with phytochrome physiology."

1. **Tang Y W & Bonner J.** The enzymatic inactivation of indoleacetic acid. I. Some characteristics of the enzyme contained in pea seedlings. *Arch. Biochem.* **25**:30-53, 1947.
2. **Galston A W.** Riboflavin-sensitized photooxidation of indoleacetic acid and related compounds. *Proc. Nat. Acad. Sci. US* **35**:10-17, 1949.
3. **Bottomlcy W, Smith H & Galston A W.** A phytochrome-mediated effect of light on the hydroxylation pattern of flavonoids in *Pisum sativum* var. Alaska. *Nature* **207**:1311-12, 1965.
4. **Hillman W S & Galston A W.** Inductive control of indoleacetic acid activity by red and near infrared light. *Plant Physiol.* **32**:129-35, 1957.