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This Week's Citation Classic

Mohr H. Investigations on phytochrome induced photomorphogenesis in the mustard seedling (*Sinapis alba* L.). *Z. Pflanzenphysiol.* **54**:63-83, 1966. [Botanischen Institut, Universität Freiburg, Freiburg, Fed. Rep. Germany]

This paper summarizes the methodological and the logical approaches used by my laboratory in research on photomorphogenesis in higher plants. Three different categories of photoresponses were recognized, and experimental evidence was presented suggesting that 'positive photoresponses' (representing one of the three categories) are the result of phytochrome induced gene expression. [The *SCI*® indicates that this paper has been cited over 160 times since 1966.]

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"It has been known since the 19th century that higher plants require light for normal development ('photomorphogenesis') and that this morphogenetic light effect is independent of photosynthesis. However, the particular light dependency of photomorphogenesis and the photoreceptor involved, presently called 'phytochrome,' a bluish chromoprotein with photochromic properties in red and far-red light, was only detected in the late 1950s. The discovery of the reversible red far-red control of plant growth and development and the subsequent *in vivo* identification and isolation of the photoreceptor pigment, phytochrome, constitutes one of the great achievements in plant biology. It was primarily a group of investigators at the Plant Industry Station, Beltsville, Maryland, headed by the botanist HA. Borthwick and the physical chemist SB. Hendricks, who made the basic discoveries and developed a theoretical framework which eventually led to the isolation of the ubiquitous red far-red reversible pigment, phytochrome.[1] It was at Beltsville that I received my postdoctoral training.

"In the 1960s the emphasis was on the 'mechanism' of phytochrome action, i.e., the biophysical and molecular steps leading from the formation of active phytochrome to the final displays (photoresponses). As a convenient guiding principle in studies about the 'mechanism' of the morphogenetic light effect we had chosen the concept that only light absorbed by the sensor pigment phytochrome permits the proper expression of those genes which control normal development. In operational terms, it was postulated that the *specific* regulation of enzyme syntheses plays the central role in photomorphogenesis. This concept has eventually succeeded. By now there is ample evidence that light *via* phytochrome controls enzyme syntheses *specifically,* and there is beautiful evidence that light *via* phytochrome controls *specifically* the appearance of new mRNAs.

"In my opinion, the significance of the 1966 paper has been that it categorized the so far confusing diversity of photoresponses and developed a unifying concept, namely, that differential gene expression is the basis of photomorphogenesis. By that time our argument depended largely on measurements of RNA and protein syntheses and on the use of inhibitors such as Actinomycin D and Puromycin.

"I believe that there are two reasons for the frequent citation of my paper. First, it contains a number of technical details which were later on adopted by other workers in the field of photomorphogenesis and, second, the concept of phytochrome-mediated differential gene expression was *not* approved originally by most of my colleagues. As a consequence, many investigators who did *not* like my ideas have referred to the paper. Thus, ironically, my paper has probably reached the status of a *Citation Classic* only because its message was not accepted originally. More recent work is reported in *Lectures on Photomorphogenesis."*[2]

1. **Hendricks S B & Borthwick H A.** The physiological functions of phytochrome. (Goodwin T W, ed.) *Chemistry and biochemistry of plant pigments.* London: Academic Press, 1965. p. 405-39.
2. **Mohr H.** *Lectures on photomorphogenesis.* New York: Springer, 1972. 237 p.