Pak. J. Bot., 4 (1): 51—53.

PHOTOTROPIC RESPONSE OF DECAPITATED COLEOPTILES

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Abstract

Unilateral illumination of decapitated coleoptiles of *Avena* and *Zea*, in the first positive range, showed phototropic response when supplied with indoleacetic acid. These observations are interprted as support for the hypothesis that the primary effect of light is to impair the basipetal movement of the auxin.

Introduction

Curvature in unilaterally irradiated organs results from lateral differences in longitudinal growth. Of the various explanations the Cholodny-Went theory, proposing an initial lateral movement of auxin, has received support (Briggs, 1963; Pickard & Thimann, 1964). Another recently proposed hypothesis holding that the primary hormonal phenomena in first-positive phototropism is a photoinduced impairment in the basipetal auxin transport had been demonstrated (Naqvi & Gordon, 1967: Gordon & Shen-Miller, 1968). Briggs (1963) has concluded that "the apical 1/2 mm of the coleoptile is the major region for lateral transport, both for the first and second positive curvature". Thus confirming the importance of the coleoptile tip in the mediation of phototropic response and also supporting the Cholodny-Went theory. However, Brauner (1922) and Reinders (1934) were able to demonstrate positive phototropic response by placing non-irradiated tips upon unilaterally irradiated *Avena* coleoptile stumps. Using decapitation technique, the present study, therefore, examines the necessity of the tip in the mediation of first-positive phototropic response of coleoptiles.

Materials and Methods

Seeds of *Avena sativa* L. (cv. Victory) and *Zea mays* L. (hybrid DC-8) were soaked for two hours in warm tap water and placed, embryo up, on moistened paper pads in petri-dishes. The dishes were covered and placed in the dark room at $25 \pm 1°$ C. To inhibit mesocotyl growth the germinating seeds were exposed to red-light (Ruby red 15W) for two hours, beginning at 24 hours (*Avena*), and for 8 hours, beginning at 48 hours (*Zea*), after planting. For irradiation in the first-positive range 70 hours (*Avena*) and 94 hours (*Zea*) coleoptiles were used.

Twelve coleoptiles were used per treatment, of which six were decapitated by removing approximately 1 mm of the tip and the remaining six were left intact to act as control. Agar blocks (3 x 4 x 1 mm) containing 0.2 mg/l of indoleacetic acid were then placed on the cut surface of decapitated coleoptiles to replace the tip. Unilateral exposure of white light was used to impose radiant densities of 500 and 1,000 MCS (EEL Light Master Photometer). Shadow-graphs were taken after 1.5 hours and the curvature was measured. Unless otherwise noted, the temperature throughout

the experimental period was maintained at 25 $\pm 1°$ C. The experiments were replicated three times with essentially similar results. Analysis of variance, at a chance probability of 1%, was used to analyse the statistical significance.

Results and Discussion

The results presented in the Table indicate that first-positive phototropic response, could be obtained by replacing the tip with IAA-agar blocks. The statistically significant decreased response of the decapitated coleoptiles, as compared with intact control, is in accordance with the observations that phototropic sensitivity diminishes rapidly in basipetal direction (Curry, 1968). It can, therefore, be reasonable to conclude that even after removal of the major region for lateral transport no marked effect on the phototropic response was observed.

These results are in close agreement with those of Brauner (1922) and Reinders (1934) as mentioned earlier. Meyer and Pohl (1956) have demonstrated that when equilaterally exposed *Avena* coleoptile cylinders were apically supplied with IAA they show reduced growth more so than the intact control. Also it has been found that blue light exposure inhibited coleoptile elongation as well as basipetal transport of ^{1}C-IAA (Gordon and Shen-Miller, 1968). Experiments with bilateral exposure of *Zea* coleoptiles to white light, where intact coleoptiles represented lighted and darkened halves of unilateral exposure, supported the hypothesis that first-positive exposure causes a reduction in diffusible auxin, decreased *Avena* curvature response as well as inhibition of the basipetal transport of ^{1}C-IAA (Naqvi & Gordon, 1967). It is pertinent to mention that Shen-Miller et al., (1969), using white light and broad and narrow spectral band of blue light, have reported that dose response for basipetal transport inhibition matches that for phototropism. Therefore, the present studies and those mentioned above further support the explanation that the primary effect of phototropic stimulation in the first-positive range, is an inhibition of the basipetal transport rather than a lateral translocation of auxin.

Table 1. Effect of light on the phototropic curvature response of intact and decapitated coleoptiles.

Treatments	500 MCS		1,000 MCS	
	Intact	Decap.	Intact	Decap.
Avena sativa L.	14.72[a]	8.77[b]	22.22[a]	14.27[b]
Zea mays L.	11.27[a]	7.05[b]	19.99[a]	12.16[b]

Mean within row accross the Table not followed by the same subscript differ at odds greater than 99:1.

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