THE EFFECT OF THE LIGHT/DARK RATIO ON MORPHOGENESIS FOLLOWING THE APPLICATION OF AUXIN TO ROOTS OF PEA SEEDLINGS

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It is well known that exogeneous factors (light, temperature, etc.) interacting with endogeneous factors, i.e. phytohormones, may influence the expression of morphological characters in a particular plant genotype. Hormone-dependent regulation of plant growth can be studied by applying morphogenetic substances to the plant. We investigated the effect of the light/dark ratio on morphogenesis after auxin was applied to the roots of etiolated pea seedlings. In this paper we wish to show the relevance of our results, using our established culture system (1), to gene controlled morphogenesis.

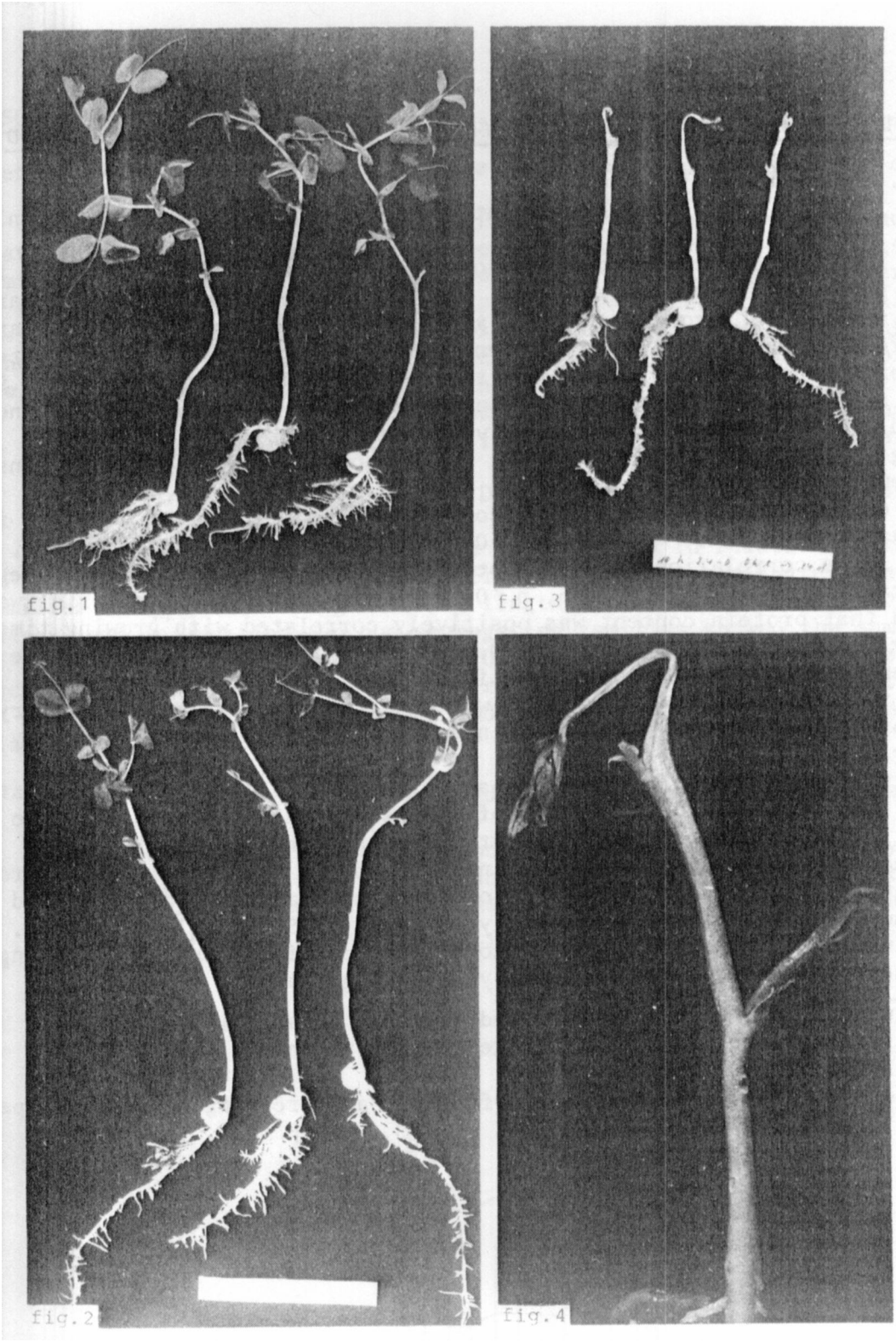
Auxin-induced morphogenesis of intact pea seedlings was strongly influenced by the light/dark ratio after the pulse (Table 1). A short pulse of the synthetic auxin 2,4-D (15 min) followed by exposure to light for ten hours induced abnormal root growth whereas shoot development was only slightly inhibited (Fig. 1). When the application-time was extended, and exposure to light reduced, the elongation of basal stem tissue in the shoot was stimulated, but natural morphogenesis of apical parts was inhibited (Fig. 2). When the auxin was applied for ten hours in the dark followed by an eight-hour dark period before further cultivation for two weeks, natural development of the shoot was strongly inhibited (Fig. 3). Numerous abnormal lateral roots were initiated together with the formation of callus-like structures. The shoots of these seedlings were able to initiate axillary buds, which in some cases developed into shoots before final inhibition (Fig. 4). This phenomenon seems to depend on breaking the apical dominance after 2,4-D was applied to the roots, probably by inhibiting the natural auxin transport from the apex. Abnormal growth such as adventitious roots or callus-like structures were also observed when the seedlings were treated with 2,4-D (10^{-4}M) for 24 hours in the dark and then cultivated under light (1).

Table 1. General morphogenetic aspects of plants treated with 2,4-D (root-applied) and then exposed to different light/dark regimes.

Duration of treatment (10^{-4}M) with 2,4-D to etiolated roots (h)	Light exposure after application (h)	Morphogenetic response after further cultivation under a light dark rhythm of 16/8 h for two weeks	
		Root development	Shoot development
1/4	10		slightly inhibited
1	9	inhibition of natural growth and induction of abnormal growth	↓
3	7		
6	4		
10	0		strongly inhibited and indiction of abnormal growth
24	16		

These examples illustrate the importance of having standardized conditions, especially light conditions, following the treatment of intact seedlings with auxin. We believe that these results clearly demonstrate how exogeneous factors such as exposure to light in the early stages of seeding development may play an important role in the expression of morphological mutants, at least if phytohormones are involved in the morphogenetic pathway.

1. Ingensiep, H. W. , et al. Morphogenetic response, translocation, and metabolism of root-applied auxin in pea seedlings. PNL 13: 21. 1981.



Figs. 1-4. Morphogenetic responses to different auxin-light treatments (see text for explanation).