INFLUENCE OF RED LIGHT ON TRANSPORT OF FLUORESCEIN IN THE MESOCOTYLS OF DARK-GROWN AVENA SEEDLINGS

B. HUISINGA

Botanisch laboratorium, Utrecht

SUMMARY

The transport velocity of fluorescein in mesocotyls of *Avena* seedlings is reduced by pre-irradiating the seedlings with red light.

In the course of an investigation on the influence of light on the distribution of growth in the *Avena* seedling (HUISINGA 1964, 1967) we postulated that part of the influence of red light might be expressed via changes in transport rates.

NAQVI & GORDON (1966) have shown that polar transport of auxin through sections of *Avena* coleoptiles is reduced by red light. HALEVY *et al.* (1964) have demonstrated that the transport of food reserves from the cotyledons of *Helianthus* seedlings towards the roots was reduced by red light.

We wanted to know whether in *Avena* seedlings not only transport in basal direction, but also in apical direction is reduced by red light.

To find this out we used fluorescein because its translocation is easily detected (see POHL 1954).

Seedlings of *Avena sativa* "Victory oats" were cultivated following the method of BLAAUW & BLAAUW-JANSEN (1964) but in total darkness and at 23 °C and high humidity. After 4 days the seedlings, having mesocotyls approximately 4–6 cm long were cut from seeds and roots and placed with their lower 1–2 mm in tapwater. Next, part of the plants received in 40 seconds approximately 4×10^4 erg. cm^{-2} of red light, the remainder being kept in total darkness throughout. The source of red light was a red fluorescent tube combined with a red selenium glass filter (see BLAAUW & BLAAUW-JANSEN 1964). Varying times after the irradiation the plants were placed with their lower ends in a 1% solution of fluorescein in tapwater. After 15 minutes the plants were observed under ultraviolet light and the length of the fluorescent part of the mesocotyl was measured. No consistent differences between irradiated and control plants could be observed in experiments in which the time elapsing between irradiation and the treatment with fluorescein was 0, 5, or 10 minutes. If this time was 15 or 30 minutes, differences between the irradiated plants and dark controls could be observed. The results of a number of experiments are shown in *table 1*.

The transport of fluorescein in the experiments described may have take place both through xylem and through living tissues. Since light acts very probably via the living cells transport through the xylem may conceivably have made the

Table 1. Length of the fluorescent part of the mesocotyl in mm, means of 8–12 plants.

	15 minutes between irradiation and fluorescein treatment.			30 minutes between irradiation and fluorescein treatment.	
Exp.	irradiated	dark control		irradiated	dark control
1	42	52	1	48	52
2	42	45	2	50	51
3	34	37	3	29	36
4	30	35	4	36	43
5	40	44	5	39	48
6	41	44	6	39	47
7	41	46	7	39	50
8	48	49			
	probability of no difference between irradiated and dark control calculated by sign test <1%			probability of no difference between irradiatied and dark control calculated by sign test <5%.	

results in *table 1* less clear than they might have been had no transport through the dead xylem elements taken place.

To find out how great the influence of xylem transport was in the above experiments we wanted to reduce transport through the xylem as much as possible. To reduce this way of transport the plants immediately after irradiation were placed with their cut ends in the solution of fluorescein and left there for only 2 minutes. Thereupon they were submerged in tapwater to preclude transpiration. *Table 2* presents the results of a number of experiments of this kind. The irradiation was given in 2 minutes with a total energy of approximately $1.2.10^5$ erg. cm^{-2}. The time the plants were left submerged varied between 5 and 60 minutes. At all those different times the fluorescent part of the irradiated plants was smaller than that of the dark controls.

Table 2 shows also that with this method the influence of the irradiation can be detected without introducing a lapse of time between irradiation and the application of fluorescein. In the experiments of *table 1* the total time required for obtaining consistent differences was at least 30 minutes. In the experiments

Table 2. Length of the fluorescent part of the mesocotyl in mm, means of 8–12 plants.

Exp. No.	Time submerged in min.	irradiated	dark control
1	15	4	22
2	30	24	29
3	60	25	37
4	30	33	42
5	10	30	37
6	20	32	42
7	15	38	47
8	15	30	34
9	5	15	26

Probability of no difference between irradiated and dark control calculated by sign test <1%.

presented in *table 2* consistent differences were found with total times of about 15 minutes.

Although it is speculative to draw conclusions from the transport of a non-physiological compound, such as fluorescein, and apply those conclusions to other, naturally occurring, substances, it seems not too unlikely that also other substances may behave in the same way in irradiated and control seedlings.

Therefore we tentatively propose that irradiation with red light may have an influence on the structure of the protoplasts of the cells so as to reduce the translocation also of other substances than fluorescein.

ACKNOWLEDGEMENT

Thanks are due to Miss J. J. van de Kaa and Miss A. W. M. Knijff for their help in carrying out the experiments.

REFERENCES

BLAAUW, O. H. & G. BLAAUW-JANSEN (1964): The influence of red light on the phototropism of Avena coleoptiles. *Acta Botan. Neerl.* **13**:541–552.

HALEVY, A. H., S. P. MONSELISE & Z. PLAUT (1964): Effects of gibberellin on translocation and on dry matter and water content in several plant species. *Physiol. Plant.* **17**:49–62.

HUISINGA, B. (1964): Influence of light on growth, geotropism and guttation of Avena seedlings grown in total darkness. *Acta Botan. Neerl.* **13**:345–487.

— (1967): Influence of irradiation on the distribution of growth in dark-grown Avena seedlings. *Acta Botan. Neerl.* **16**:197–201.

NAQVI, S. M. & S. A. GORDON (1966): Auxin transport in Zea mays coleoptiles I. Influence of gravity on the transport of indole acetic acid 2-^{14}C. *Plant Physiol.* **41**:1113–1118.

POHL, R. (1954): Die fluorescenz-mikroskopische Analyse des Wasserweges in der Avena Koleoptile. *Zeit. Bot.* **42**:63–72.