INTERACTION OF RED AND BLUE LIGHT
ON THE DEVELOPMENT OF THE PROTONEMA
AND BUD FORMATION IN POHLIA NUTANS

By
G. C. Mitra, L. P. Misra and Chandra Prabha

(Received January 21, 1965)

Summary

Red light induces bud formation in Pohlia nutans, but it is not sufficient for their normal development. For their development into leafy shoots 11 hours red light followed by 6 hours blue in a 24-hour cycle seems to be the best. It produces results almost similar to that of white light of 17 hours duration. By changing the order in the sequence of the above treatment (namely, 6 hours blue light followed by 11 hours red light) many buds are inhibited. Blue light alone completely inhibits bud formation but supplemented with red light this inhibitory effect of blue light is counteracted and buds are formed, provided a minimum exposure of red light is maintained. Red light, like kinetin, counteracts inhibitory effects of coconut water on bud formation. The results obtained emphasize the similarity in action of red light and kinetin on bud formation. Blue light promotes a very good growth of the protonema and in any combination with red light has produced greater protonemal growth than red light alone of 17 hours duration.

Introduction

Mitra et al. (1959) have shown that buds are formed on the protonema of Pohlia nutans (Hedw.) Lindb. growing on the basal medium under red light but not under blue light. In a subsequent publication (Mitra, Misra and Kaul, 1962) it has been shown that this effect of bud inhibition under blue light is, however, overcome when the basal medium is supplemented with kinetin and that the basal medium containing coconut water inhibits bud formation in P. nutans. In this case also kinetin counteracts the inhibitory effect of coconut water on bud formation. The above mentioned findings which indicate: (a) that the combined effect of red and blue light can further elucidate our knowledge on the development of the protonema as well as the formation of buds and (b) also that red light alone or red light in combination with blue light can counteract the inhibitory effect of coconut water on bud formation in P. nutans, led us to experiment on these lines. The findings are given below. The observations have been confirmed by repeating the experiments.
Interaction of red and blue light

Material and Methods

Aseptic cultures are prepared from small protonemal inoculations on modified² Vorn's medium and on the same supplemented with 15% coconut water. The pH of the media is adjusted to 5 approximately. The cultures are grown under fluorescent light (Phillips' "Daylight") adjusted to about 2300 lux at the level of the cultures and also under red light (580–700 μm wavelengths) and blue light (400 to 530 μm wavelengths). The chambers of white, red and blue light are arranged so that the irradiation intensity at the level of the cultures is effectively the same (about 950 ergs/cm²/sec) for each source. The energy is determined by means of a photo-electric cell calibrated for each source of light against a thermopyle. The same procedure as given in the previous experiment (Mitra et al. 1959) is adopted to obtain the coloured sources. The cultures are exposed to different light conditions for different durations as given in the Table and kept in the dark for the remaining period of a 24-hour cycle. The numericals and the alphabets, R, B, W, used in the Table indicate hours of irradiation, red light, blue light and white light respectively. In the supplementary series of red light and blue light two sequences have been adopted in a 24-hour cycle, namely, Red → Blue → Dark and Blue → Red → Dark constituting the supplementary series: (11R + 6B), (6B + 11R), (11B + 6R) and (6R + 11B). For example, the treatment (11R + 6B) series will mean exposure of the cultures to 11 hours red irradiation followed by 6 hours blue irradiation in a 24-hour cycle. The temperature is regulated at 24–26° C.

Experimental Results

1. Interaction of red and blue light on bud formation. Some data concerning the interaction of red and blue light are summarized in the Table. The number of those buds which can be counted with a hand lens (× 10) has been given in the table. Certain tiny buds capable of being resolved only under the high power of the microscope are also made out in addition to those that are seen under the hand lens. These tiny buds are designated throughout the text as bud rudiments. In certain treatments, namely, effects of red light of 17 and 11 hours duration and in all the supplementary series of red and blue light these bud rudiments, may be a normal or an abnormal type, arise and vary greatly in numbers in the cultures. It will be evident from the table that under white light of 17 hours duration and under (11 R + 6 B) series not only buds appear earlier but they are also formed in greater number. In (6 R + 11 B) and (6 B + 11 R) series almost the same number of buds are formed. In (11B + 6 R) series a bud seldom arises. Leafy shoots develop in (11R + 6 B) series in greater abundance in comparison to

¹ Major salts of Vorn's medium plus the following have been used in mg per litre of nutrient medium: Ferric citrate—10; H₂SO₄, sp.gr. 1.83—0.005 ml/litre; MnSO₄.4H₂O—3; ZnSO₄.7H₂O—0.5; H₂BO₃—0.5; CuSO₄.5H₂O—0.025; Na₂MoO₄. 2H₂O—0.025; CoCl₂—0.025; NiCl₂—0.025; KI—0.75; Thiamin HCl—0.1; Riboflavin—0.05; Pyridoxine HCl—0.1; Calcium pantothenate—0.8; Nicotinic acid—0.5; Inositol—0.5; Cholin HCl—0.1; Folic acid—0.1; Biotin—0.005; p-aminobenzoic acid—0.05; Sucrose—10,000; Agar Agar (DIFCO)—6,500.