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PHOTOMORPHOGENESIS IN PENICILLIUM ISARIIFORME II. THE ACTION SPECTRUM FOR LIGHT-INDUCED FORMATION OF COREMIA

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SUMMARY

The action spectrum for the development of coremia in *P. isariiforme* was determined by means of cyclic illumination. This spectrum shows a peak at 470 nm to 480 nm. It resembles the action spectrum for light-induced sporulation in the same fungus, but gives no further information about the photoreceptor. Possibly an unknown pigment causes a distortion of the action spectrum in this fungus.

1. INTRODUCTION

In their study on *P. isariiforme* CARLILE *et al.* (1962) established that the light requirement for initiation and growth of coremia was absolute. In an earlier study (BENNINK 1972) it was demonstrated that the action spectrum for sporulation in *P. isariiforme* differed strongly from action spectra for light-induced reactions obtained with other fungi, e.g. *Phycomyces blakesleeanus* and *Trichoderma viride*. For this reason it seemed to be of interest to determine the action spectrum for the formation of coremia in *P. isariiforme* and to compare this with the action spectrum for sporulation in the same organism.

2. MATERIAL AND METHODS

Penicillium isariiforme Stolk & Meyer, strain 530, was obtained from the C.B.S. (Centraalbureau voor Schimmelcultures, Baarn, Holland). The fungus was cultivated on the same medium as mentioned in a former study (BENNINK 1972). Inoculation was done in a streak of about 5 cm on 30 ml medium in a Petri dish. The dishes were kept in a dark incubator at 25 °C (±1 °C). Illuminations and light measurements were performed in the same way as described earlier (BENNINK 1972).

3. RESULTS

Preliminary experiments were carried out with five-day-old cultures that received from 200 to 500 erg.cm^{-2}.sec^{-1} for 10 to 300 seconds at various wavelengths of monochromatic light.

Although, as with sporulation, the formation of coremia appeared to be an all-or-none response towards illumination, it was impossible to delineate a sharp limit between "all" and "none" in this case.

Cyclic illumination provided the key for the solution of the problem. Sixty-five hours old cultures were illuminated for 4 to 14 seconds with monochromatic light three to five times a day with intervals of $1^1/_2$ hours during three subsequent days. In these experiments several light intensities were used. As was to be expected, no dose-response curves could be determined, but requirements of the Bunsen-Roscoe reciprocity-law are met in these experiments as is shown in *table 1.*

In these experiments very good results were obtained with cyclic illuminations at a light intensity of 128 erg.cm^{-2}.sec^{-1}, the maximal intensity most of the available filters could transmit in our apparatus. In this way a number of experiments were performed with the filters 382 nm to 530 nm.

Every filter was used four to six times and the experiments were always

Table 1. I × t relation for the initiation of coremia in *P. isariiforme.*

Wavelength nm	Intensity (I) erg.cm^{-2}.sec^{-1}	Minimum effective time of illumination (t)	I × t
426	320	4–6 sec	1600
426	237	6–8 sec	1659
426	141	10–12 sec	1551
426	128	12–14 sec	1664
476	320	2–3 sec	800
476	180	4–6 sec	900
476	128	5–7 sec	768
476	90	10–12 sec	990

Table 2. Initiation of coremia in *P. isariiforme* in connection with wavelength and time of illumination.

Wavelength nm	Intensity erg.cm^{-2}.sec.$^{-1}$	Mean effective time for initiation of coremia sec.*	Total energy erg.cm^{-2}	Rel. quantum efficiency
382	128	16.0 (2.0)	2048	0.45
410	128	17,5 (1,8)	2230	0.38
426	128	13.1 (1.6)	1677	0.49
434	128	12.0 (1.4)	1536	0.53
449	126	12.3 (1.6)	1550	0.50
459	128	12.3 (1.5)	1574	0.49
466	126	8.7 (1.6)	1096	0.69
470	128	6.8 (1.4)	870	0.86
476	128	5.8 (0.5)	742	1.00
481	128	7.0 (1.3)	896	0.82
488	128	8.8 (1.5)	1126	0.64
491	128	15.7 (1.7)	2010	0.35
499	128	18.3 (1.8)	2342	0.30
510	128	>35 (–)	4480	<0.11

* standard deviation.

performed in duplicate. The results of these experiments were determined at the fourth day after the start of the illuminations. In the centre of the inoculation streak a row of coremia was initiated when the duration of the illumination had been sufficient. In this way a sharp reproducible limit between initiation of coremia and no reaction could be estimated. The results are given in *table 2.*

In *table 2* the relative quantum efficiency is calculated according to the following formula:

$$1 \text{ erg.cm}^{-2}.\text{sec}^{-1} = \frac{\lambda}{1987} \times 10^{11} \text{ quanta. cm}^{-2}.\text{sec}^{-1}$$

A plot of these values versus wavelengths yields the action spectrum for light initiated coremia as is shown in *fig. 1.*

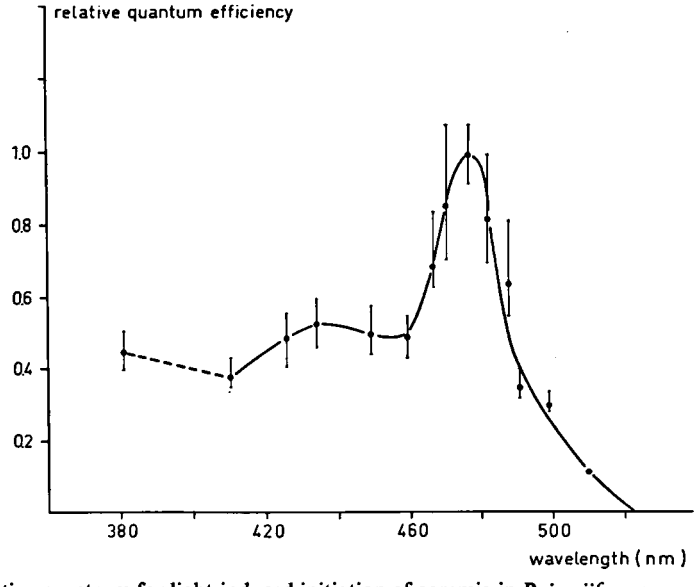

Fig. 1. Action spectrum for light-induced initiation of coremia in *P. isariiforme.*

4. DISCUSSION

The action spectrum determined for light-induced initiation of coremia appears to have a strong similarity to the action spectrum for sporulation in the same organism (BENNINK 1972). Wavelengths over 520 nm show no activity. In both cases maximum activity is found between 470 and 480 nm. Light of wavelengths below 450 nm shows a significantly lower activity which is, however, about twice as high as for sporulation in the same region.

FARAJ SALMAN (1971) obtained an action spectrum for light-induced zonation of coremia in *P.claviforme.* This spectrum has a maximum at 450–460 nm and a shoulder at 470–480 nm. Again, as with the action spectrum for light-induced

sporulation, the action spectrum for the formation of coremia is strikingly different from those published by other authors. This holds especially for SALMAN's (1971) spectrum for the related phenomenon in the related species *P. claviforme*, but also for other light-induced reactions in fungi, as described by CURRY & GRUEN (1959); DELBRÜCK & SHROPSHIRE (1960); GRESSEL & HARTMANN (1968).

The notable absence of a peak at 450 nm in the present action spectrum and, on the other hand, the presence of a peak corresponding with a shoulder in Salman's spectrum requires an explanation which might be found in the presence of other pigments beside the photoreceptor, as was also concluded in the previous paper (BENNINK 1972).

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