EFFECT OF ULTRAVIOLET RADIATION ON THE RESPONSE OF *PANICUM REPENS* L. TO INOCULATION WITH *PYRICULARIA* SPP.

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ABSTRACT

Ultraviolet irradiation of *P. repens* leaves before inoculation not only increased their susceptibility to a compatible isolate of *Pyricularia* but also altered their typical resistant response to an incompatible isolate. Irradiated leaves aged faster than unirradiated leaves. However, the effect of UV could not be duplicated by ageing unirradiated leaves before inoculation.

INTRODUCTION

THE response of plants to infection by fungi has been reported to be influenced by ultraviolet irradiation[1-4]. Several effects of UV irradiation on leaves are known[5,6]. The object of the present investigation was to find out if irradiation of *P. repens* leaves before inoculation would alter their response to compatible/incompatible isolates of *Pyricularia* and to study the effect of irradiation in terms of UV induced ageing of the leaves.

EXPERIMENTAL AND RESULTS

A set of 16-20 detached *P. repens* leaves for each treatment was floated on distilled water and irradiated at a distance of 25 cm from a 15 W General Electric germicidal lamp for 1–15 min. The leaves were transferred to 40 ppm benzimidazole solution and inoculated with conidia (10×10^4/ml) of an incompatible (P_1 or M_1) or a compatible (PR) isolate of *Pyricularia*. Irradiated uninoculated controls were also maintained which remained free from infection. The leaves were incubated under diffuse light (12 h light/dark cycle) in a growth room for a total period of 7 days. Daily observations were made for symptom development.

Unirradiated leaves inoculated with the incompatible P_1 isolate showed the typical resistant response. However, irradiated leaves inoculated with the same isolate showed chlorotic lesions without green islands (Fig. 1 *a*). Examination of the lesions for hyphal development showed that the fungus had generalized in cells of the chlorotic areas. Both unirradiated and irradiated leaves inoculated with the compatible PR developed typical susceptible symptoms with green islands but more chlorosis developed around lesions in the latter treatment (Fig. 1 *b*). The incompatible M_1 did not produce symptoms either in the control or irradiated leaves. The type of symptoms produced by the P_1 and PR isolates, the time of their appearance and the frequency of their development in the different treatments are shown in Table I.

It is evident from the results that the incompatible P_1 isolate produced chlorotic lesions on leaves irradiated for 2 minutes and more as against the typical resistant response in unirradiated leaves. It may be further noted that the number of such lesions increased with increasing irradiation time and the lesions appeared earlier on leaves irradiated for 5 minutes and more than on leaves irradiated for a shorter duration.

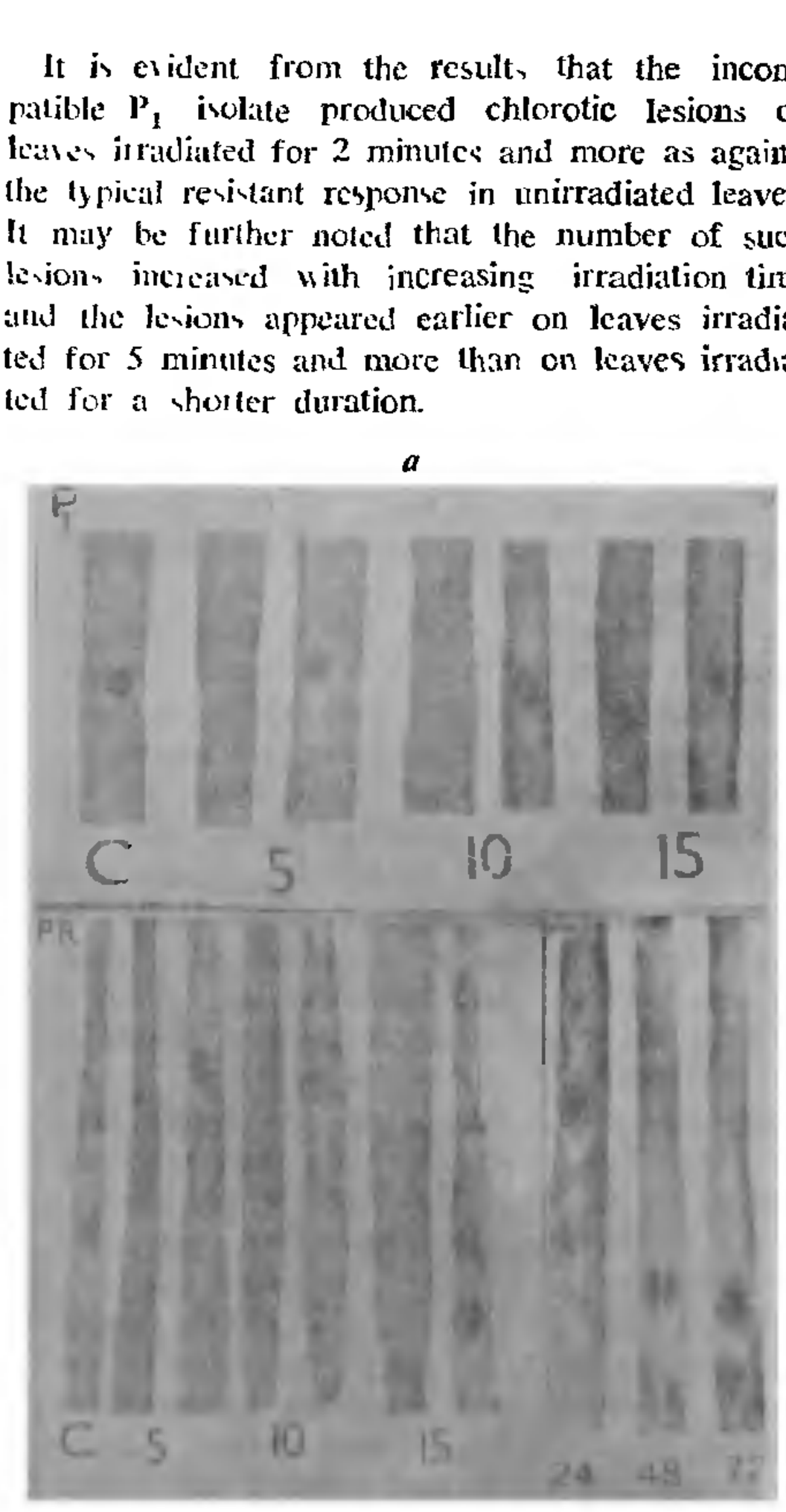

FIG. 1. *a–c*, (*a*, *b*) Symptoms produced on unirradiated (C) and UV irradiated *P. repens* leaves by an incompatible (P_1) and a compatible (PR) isolate of *Pyricularia*; irradiated uninoculated leaves are also shown. (*c*) Symptoms produced by PR on aged leaves. (Refer text for details).

In leaves inoculated with the compatible PR, typical susceptible symptoms developed earlier in

TABLE I

Response of UV irradiated P. repens *leaves to inoculation with an incompatible/a compatible isolate of* Pyricularia

Exposure time (min.)	P_1 (incompatible)		PR (compatible)	
	Day when symptom appeared	Inoculated sites showing symptom (%)	Day when symptom appeared	Inoculated sites showing symptom (%)
0 (control)	3	100·0^R	5	50·0^S
1	3	100·0^R	3	58·5^S
2	5	7·5^C	3	65·8^S
3	5	20·0^C	3	82·5^S
5	3	30·7^C	3	100·0^S
10	3	58·5^C	3	100·0^S
15	3	82·0^C	3	100·0^S

R — typical resistant response (visible browning). C — chlorotic lesions.
S — typical susceptible response (spindles with green islands).

irradiated than control leaves, and this effect was evident even with one minute irradiation. It may also be seen that the number of lesions increased with increasing irradiation time. In fact, in leaves irradiated for 5 minutes and more, lesions developed at all inoculated sites.

Whether the above noted effects were due to UV induced ageing of the leaves was next studied. Sixteen detached leaves for each treatment were irradiated with UV for 15 minutes and floated on benzimidazole solution as before. One set of unirradiated control and irradiated leaves were left under diffuse light. Seven sets of control and irradiated leaves were left in total darkness. One set of control and irradiated leaves from the dark treatment was removed every 24 h and observed for development of chlorosis as an index of ageing in the leaf tissue. Similar observations were made on leaves kept under light. The response of the leaves to the treatments is shown in Table II. It is obvious from the results that irradiated leaves aged faster than control leaves.

Although irradiated leaves aged faster than control leaves the effect of UV on the response of the leaves to the two isolates could not be duplicated by ageing of unirradiated leaves before inoculation. Unirradiated leaves aged up to 5 days before inoculation did not show any altered response to the incompatible P_1 or the compatible PR. With the latter isolate, however, more chlorosis developed around lesions in leaves aged for 48 h and more (Fig. 1 *c*).

TABLE II

Ageing in UV irradiated P. repens *leaves*

Days after irradiation	Leaves showing chlorosis (%)			
	Light		Darkness	
	Control	Irradiated	Control	Irradiated
1	0	0	0	0
2	0	0	0	0
3	0	0	0	68·7
4	0	0	0	100·0
5	0	0	0	100·0
6	0	0	0	100·0
7	0	0	37·5	100·0
8	0	43·7	..	..
9	0	62·5	..	..
10	0	100·0	..	..

DISCUSSION

Irradiation of *P. repens* leaves with ultraviolet light before inoculation altered their response to inoculation with a compatible/incompatible isolate of *Pyricularia*. The incompatible (P_1) isolate produced chlorotic lesions in irradiated leaves as against the typical resistant response in unirradiated control leaves (Fig. 1 *a*). Irradiation, however, did not alter the response of the leaves to the incompatible M_1 isolate. This isolate appears to have lost the ability to differentiate the infection peg due to mutation[7] and it is not, therefore, surprising that irradiated leaves did not show any altered response to this isolate. Irradiated leaves also showed an increased susceptibility to the compatible PR isolate and a greater number of lesions developed earlier on irradiated than control leaves (Table I).

Results presented in Table II would show that UV irradiated leaves aged faster than unirradiated leaves. However, the altered response of irradiated *P. repens* leaves to the two isolates of *Pyricularia* could not be ascribed to UV induced ageing of the leaves. Ageing of unirradiated leaves before inoculation did not alter their typical response to the compatible PR and the incompatible P_1 isolates.

Several suggestions have been made to explain the altered response of UV irradiated leaves to infection by fungi. Buxton *et. al.*[1] speculated that increased infection by *Botrytis fabae* on irradiated broad bean leaves might be due to increased production of foliar exudates that stimulated the pathogen. Others considered that UV irradiation caused injury to the leaf epidermis. It seems unlikely, however, that the above effects of UV could explain the altered response of irradiated *P. repens* leaves to the incompatible P_1 and PR isolates of *Pyricularia.* The effects of UV could not be reproduced with physical injuries to the leaves before inoculation (unpublished observations). In fact, diffusates and extracts of physically injured leaves were less stimulatory to germ tube growth in the compatible PR and more inhibitory to germ tube growth in the incompatible P_1 than those of uninjured leaves[9]. Studying the effects of UV irradiation on resistance of barley (*Hordeum vulgare*) to *Helminthosporium teres* and *H. sativum,* Chakrabarti[10] concluded that increased susceptibility of irradiated leaves was due to partial inactivation of a performed fungal inhibitor present in resistant barley leaves. We have similar evidence to indicate that UV irradiation of *P. repens* leaves before inoculation affects the acccumulation of fungitoxic material in epicuticular waxes. The results of these studies will be published elsewhere.

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EVOLUTION OF STOMATAL COMPLEX IN EMBRYOBIONTA

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ABSTRACT

A survey has been carried out of the stomatal apparatus in the various 'type' taxa of the Embryobionta as suggested in the classification proposed by Cronquist, Takhtajan, and Zimmermann (1966). The study includes not only the true leaves of higher plants but the scaly leaves of *Psilotum, Rhynia, Equisetum,* and *Eqhedra* have also been taken into account. It is seen that the stomatal apparatus is considerably different in its organization among the taxa examined suggesting the polyphyletic origin of the diverse groups of the plant kingdom.

INTRODUCTION

A RECORD of the various characters of the leaves, forms the subject-matter of this, an earlier communication (Paliwal *et al.,* 1976) has been widely employed in studying the history of the group. For example, the analysis of the fossil leaf characters has been important in discussions of the origin of the angiosperms (Sinnott and Bailey, 1914; Axelrod, 1952, 1960, 1970; Scott *et al.,* 1960), their subsequent evolution and diversity (Wolfe and Barghoorn, 1960; Takhtajan, 1969; Delevoryas, 1971), and their distribution through time and space (Cain, 1944) and in paleolimatic interpretations (Wolfe and Hopkins, 1967; Axelrod and Bailey, 1969; MaGinitie, 1969; Wolfe, 1971; Dilcher, 1973).

In the present survey, the variation in the organization of the stomatal apparatus has been considered in the Embryobionta as a whole which has been rather ignored (since studies have been mostly restricted to the familial, generic, or specific