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The x-rays induced mutations in *Aspergillus giganteus* Wehm. mut. *alba* Zurz.

A. ZURZYCKA

In the previous studies on the photomorphosis in *Aspergillus giganteus* mut. *alba* it was established (Zurzycka 1963 a and b) that there is probably no direct relationship between the elongation of the conidiophores and the synthesis of carotenoid pigments. The experimental data suggest that the carotenoids dont play the role of a photoreceptor, but rather act as screening pigments, protecting the plant against the high light intensities. In *Aspergillus giganteus* and in *A. giganteus* mut. *alba*, however, the elongation of conidiophores and the synthesis of pigments are so closely related that the further investigation of photoreception presents many difficulties. Therefore it seemed necessary to find such objects in which these two processes would be separated or take place with different rates. The present paper deals with description of mutants of *A. giganteus* mut. *alba*, which have the desired morphological features.

MATERIAL AND METHODS

The preliminary experiments have demonstrated that *Aspergillus giganteus* mut. *alba* is very resistant to ultraviolet rays, therefore the species was irradiated with x-rays. The irradiations were carried out in 1963 in Institute of Cultured Plant Breeding (Institut für Kulturpflanzenforschung, Gatersleben, DDR). The x-rays apparatus type 3-54 (Röntgen-Tiefen-Therapie-Anlage 3-54), operated at 180 KVP and 12 mA, with 0,5 Cu filter, delivering 140 r/min was used. The spores were inoculated on nutrient agar, germinated 12 or 36 hours in darkness and then irradiated with different x-rays doses and cultivated in light and darkness. The spores produced by irradiated cultures were sown on nutrient agar (Zurzycka 1955) and cultivated in light and darkness for many generations. The cultures differing morphologically from *A. giganteus* mut. *alba* were isolated and kept in culture at least two years. Then one spore cultures were prepared and characterized by the height of the conidiophores, size of conidial vesicles, dry weight and carotenoid content of mycelia.

RESULTS

The irradiation of germinating spores with x-rays, even with 80 Kr, does not injure the further development of the mould. The only irradiation effect observed consisted in the subsequent formation of a small number of long conidiophores

Table 1

The characteristics of x-rays induced mutants

The mutant	X-rays dosis Kr	The carotenoid content calculated as μg β-carotene/1g of dry weight		The height of conidiophores, mm		The morphology of conidiophores					
						light			darkness		
		light	darkness	light	darkness	vesicle length μ	vesicle breadth μ	conidiophore breadth μ	vesicle length μ	vesicle breadth μ	conidiophore breadth μ
Aspergillus giganteus mut. *alba*	—	169.2	—	25.0	3.5	124.8	36.9	18.0	27.5	24.2	11.4
A 5	4	234.7	—	7.4	2.8	—	—	23.9	47.1	17.7	9.7
A 5 bis	4	—	—	2.1	2.4	29,5	16.4	9.1	29.7	13.9	6.9
A 10	20	59.6	—	6.9	2.4	181.3	82.1	36.2	23.5	16.2	11.7
A 10 bis	20	6	—	1.8	1.8	33.3	16.1	5.6	42.6	19.3	9.4
A 27121	72	153.8	—	2.2	1.5	113.7	60.0	24.7	22.8	10.9	6.4
A 34251	44	76.6	—	25.2	9.5	201.7	67.3	45.0	118.2	45.3	22.3
A 12	40	8.0	—	11.7	5.2	—	—	not measured	68.6	22.9	13.1

in darkness. This phenomenon disappeared completely in the next generation. The morphological changes of the mould appeared in the form of sectors in the normal mycelium. More frequently the development of the mould was irregular during many generations and afterwards suddenly changed and stabilized. All the organisms recovering the blue pigment in the spores were eliminated. During this work seven distinct mutants are obtained. Their characteristics are summarized in Table 1.

The description of *Aspergillus giganteus* mut. *alba* was given elsewhere (Zurzycka 1963 c). It is an organism developing very well in light and darkness, but in darkness it produces only short conidiophores (2—3 mm) with nearly round vesicles; in the light the long (25 mm) conidiophores are formed. The conidial heads are larger, clavate and the conidiophores are yellow pigmented with carotenoids. From this organism the following mutants were isolated:

A 5. The colonies growing on nutrient agar develop very well in light and darkness. In darkness *A 5* differs only sightly from *A. giganteus* mut. *alba*, but in light this mutant forms shortened conidiophores very strongly coloured with carotenoids. The pigment content is so high that the carotenoids appear also as drops or crystals in conidiophores. The mutant has lost the ability to sporulate in light; in darkness, however, its sporulation is abundant.

A 5 bis. The colonies of this mutant have the same appearance in light as well as in darkness. The conidiophores are short, delicate, slightly curly and frequently branched; they are colourless.

A 10. The cultures grow vigorously on the nutrient agar. In darkness the mutant does not differ from the maternal organism. In light, however, the elongal tion of conidiophores and the sporulation are partially inhibited. The conidia-heads have very characteristic appearance producing the conidia only on their upper part.

A 10 bis. The mycelium is well developed in darkness and in light, forming many aerial hyphae. The conidiophores are short, delicate and abnormally branched. In darkness the mycelium is colourless, in light weakly pigmented. .

A 27121. This mutant is very similar to *A* 10 mutation but its conidiophores are shorter and much intensively coloured with carotenoid pigments.

A 342451. This mutant appeared in the culture of *A. giganteus* mut. *alba* beeing irradiated with 44 Kr in three subsequent generations. In light the size and the shape as well as the pigment content are similar as in maternal organism, but the mutant has the tendency to increased elongation even in darkness. It is the only mutant able to elongate in darkness. The conidial heads are of the same shape in light and in darkness. The carotenoids are formed only in light.

A 12. This mutation is not stabilized till now. It is the only isolate which has a small amount of carotenoids in light and which is able to elongation of conidiophores. In higher light intensities (1000 lux) the conidiophores are sterile; in the intensity of 100 lux they sporulate normally. The higher light intensities have a harmful action on the development — then the conidiophores are irregular and fragile.

DISCUSSION

The mutants obtained with x-rays irradiation of *Aspergillus giganteus* mut. *alba* can be separated into three different developmental groups:

The first group involves the organisms which have lost completely the ability to photomorphosis i.e. to elongation of conidiophores and synthesis of carotenoids. Two mutants belong to this group, namely *A 5 bis* and *A 10 bis*.

The second developmental path represent these mutant forms (*A10* and *A 27121*) which produce in light the shortened conidiophores, but they are able to synthetize the same or even greater quantities of carotenoid pigments as maternal organism.

The mutant *A 342451* is the only representative of the third group. It shows the increased growth of conidiophores in light as well as in darkness. In spite of fact that the conidiophores grown up in darkness are shorter than those produced in light, they are several times longer as those in normal cultures. This mutant is most interesting from the theoretical point of view; it is supposed to be most suitable form for studies of the first biochemical steps caused by the action of light.

In the present work such mutants are also obtained in which irradiation affects the process of sporulation in light. *A. giganteus* mut. *alba* has the normal light sporulation. By contrast the mutant *A 10* shows a diminished ability to sporulation and *A 5* is almost completely unable to produce conidia in light. It is noteworthy that all these organisms sporulate vigorously in darkness.

As could be seen from these studies the mutation which was supposed by Böhmer (Thom and Raper 1945) to take part in the origin of *Aspergillus giganteus* from *A. clavatus*, is really effective in production of different morphological features in this series of the *Aspergilli*.

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Insitute of Plant Physiology
Polish Academy of Sciences
Kraków, Grodzka 53, Poland

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Mutanty Aspergillus giganteus Wehm. mut. alba Zurz. indukowane promieniami rentgena

Streszczenie

W pracy podano krótką charakterystykę mutantów *Aspergillus giganteus* Wehm. mut. *alba* Zurz. uzyskanych przez naświetlenie organizmu macierzystego promieniami Rentgena.