The results of this study (7) not only demonstrate the usefulness of a long-term preservative method of maintaining biologic forms and races of *F. oxysporum* but indicate that maintenance of the fungi as the original "wild type" is due to survival as a dormant propagule.

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12 July 1961

Photoperiodic Response of an Albino Mutant of Einkorn Wheat in Aseptic Culture

Abstract. An albino mutant of einkorn wheat which lacks plastid pigments was cultured in a test tube on nutrient agar medium containing 8 percent sucrose, under long and short photoperiods. The plants showed typical photoperiodic responses to long and short days, suggesting the presence of a pigment system, other than plastid pigments, which is sensitive to dim radiation.

In studies of photomorphogenesis, it would be desirable to separate the individual pigments or pigment systems from the whole-light-absorbing pigments in the tissues or organs concerned, since each pigment is expected to have a different function in the process of photomorphogenesis. Thus, albino or abnormally colored plants which lack some of the pigments as a result of spontaneous or artificial mutations may serve as useful experimental materials. Under field conditions, however, it is difficult to sustain the growth of albino plants until flower initials are formed. I succeeded in growing spring wheat to flower initiation in total darkness on nutrient agar media in test tubes (see *1*).

The experiment reported here was conducted to test the response of the albino plants of einkorn wheat to long and short photoperiods by means of aseptic culture in test tubes.

The material used was an x-ray-induced mutant strain of einkorn wheat (*2*). In germination, the strain segregates normal green and albino seedlings in the ratio of 3 to 1. The plastid pigments of seedling leaves were analyzed according to the method of Koski and Smith (*3*). Neither chlorophylls nor carotenoids were found under the experimental conditions described elsewhere (*4*) (Fig. 1).

The culture medium, which contained modified White's minerals (*1*), 8 percent sucrose, 1 percent dried brewer's yeast in suspension, and 0.8 percent agar, was poured into test tubes (180 by 18 mm) in the amount of about 10 ml per tube. All the test tubes were then autoclaved at 1.2 kg above atmospheric pressure for 15 minutes.

The photoperiodic treatments were given by automatic artificial illumination from 20-watt fluorescent daylight tubes and a 40-watt incandescent lamp. The luminosity at plant level was about 1200 lux in 8 hours for a short day. For a long day, the illumination was supplemented to the extent of about 100 lux by using the incandescent lamp only for the remaining 16 hours.

The plants were grown at a temperature of 25 ± 2°C for 8 hours at the higher intensity and at a temperature of 20 ± 2°C for the 16 hours of lower-intensity illumination.

The seeds heterozygous for albino were sterilized with 10-percent chlorinated lime for 30 minutes and washed with sterilized distilled water. Then they were placed on the nutrient agar medium in the test tubes. About 10 days after sowing, the germinated albino and green segregants, which were kept at 25 ± 2°C in light, were steeped in the agar medium in order to have a better chance of absorbing the nutrients through the leaf surface.

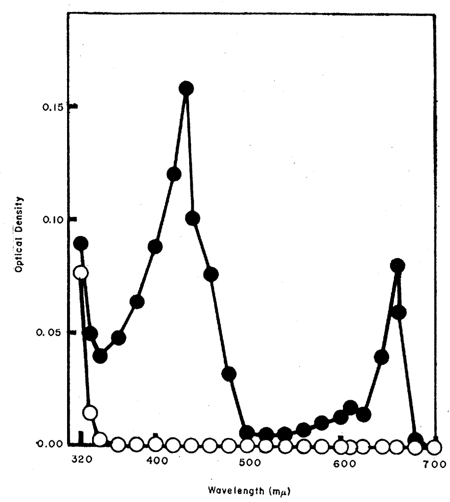

Fig. 1. Absorption spectra of ether extracts from leaves of normal green (solid circles) and albino (open circles) seedlings grown at 26°C.

All the plants were then subjected to the photoperiodic and temperature conditions mentioned above. Observation was made on days 67 and 107 after germination.

Table 1 shows that the albino plants, which are free of the plastid pigments, respond to the photoperiods just as the normal green plants do. Albino plants subjected to the long-day treatment produced flower primordia, and flower initiation was inhibited by the short day.

The sensitivity to light of the albino plant is, however, somewhat less than that of the normal green plant. The number of leaves formed on the main axis prior to flower initiation, which is generally considered a criterion of flowering response, is significantly greater in the albino plants than in green plants under the inductive long photoperiod.

The net accumulation of dry matter in the shoot is greater under the long photoperiod than under the short day

Table 1. Cultures of normal green and of albino wheat plants in test tubes under long- and short-day photoperiods.

Type	Plants observed (No.)	Plants with flower initials (%)	Leaves formed on main axis (No.)	Length of stems (mm)	Flowering stages*	Dry wt of shoots (mg)
			Long days (*N, 67*)			
Green	16	100	7.94 ± 0.17	128.6 ± 6.0	3.1 ± 0.1	43.1 ± 3.1
Albino	16	100	8.63 ± 0.12	45.1 ± 8.0	3.0 ± 0.2	41.3 ± 2.2
			Short days (*N, 67*)			
Green	12	0	>8.33 ± 0.19	†	0	31.9 ± 1.7
Albino	12	0	>8.80 ± 0.29	†	0	31.6 ± 1.9
			Short days (*N, 107*)			
Green	7	0	>11.00 ± 0.57	†	0	73.3 ± 10.1
Albino	11	0	>12.09 ± 0.30	†	0	54.8 ± 5.9

* The stage was arbitrarily assigned, from 0 to 5, to correspond to the completely vegetative state and heading, respectively (*6*). † All plants were rosetted, and stem elongation was not visible.

in both the green and the albino plants.

These results suggest that the albino plants as well as the normal green plants have a pigment system, other than the plastid pigments, which is sensitive to photoperiodic dim light. This pigment system has, as the results indicate, some effects on the promotion of growth and development by the long photoperiod in both the albino and the green plants. Promotion of the growth of fern gametophyte on sucrose medium by dim or red light of low dosages was reported and related to the nonphotosynthetic light requirement or the red–far-red absorbing system in the photomorphogenesis of plants (*5*). The plastid pigments, chlorophylls and carotenoids, do not seem to have a leading role in photoperiodism in wheat and, presumably, in many other plants (*6*). They would seem to favor, however, the flowering response through the production of some metabolites or the reaction of photosynthesis in high light intensity.

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20 June 1961

Genetical and Geographic Studies on Isoniazid Inactivation

Abstract. Rapid and slow inactivators of isoniazid are homozygotes, and intermediate inactivators are heterozygotes. There is no dominance between the two alleles. The chasm between Eskimos and Caucasians in isoniazid metabolism is bridged by our investigation of the races in the Far East.

In 1956 we succeeded in measuring the biologically active plasma concentration of isoniazid with the simple and convenient vertical diffusion method (*1, 2*). Since then we have studied the inactivation of isoniazid in the blood of more than 3000 healthy and tuberculous persons and have found that the frequency distribution curve is trimodal.

Table 1. Population genetical data.

Races and districts	No. of subjects	No. of inactivators: Rapid		Intermediate		Slow		Frequencies of alleles			Test for random mating	
		No.	%	No.	%	No.	%	"Rapid"	"Slow"	σ	χ^2	p (d.f. = 1)
Japanese*												
Hokkaido	122	53	43.5	58	47.5	11	9.0	0.6721	0.3279	0.0425	0.755	30–40%
Tohoku	94	55	58.5	32	34.0	7	7.5	0.7553	0.2447	0.0443	0.587	40–50
Shin-etsu	40	20	50.0	17	42.5	3	7.5	0.7125	0.2875	0.0716	0.056	80–90
Hokuriku	26	14	53.8	10	38.5	2	7.7	0.7308	0.2692	0.0870	0.013	80–90
Tokyo	166	79	47.6	71	42.8	16	9.6	0.6898	0.3102	0.0359	0.000	<95
Kanto	217	88	40.6	103	47.4	26	12.0	0.6429	0.3571	0.0325	0.246	60–70
Tokai	126	48	38.1	64	50.8	14	11.1	0.6349	0.3651	0.0429	1.152	20–30
Kansai	165	62	37.5	80	48.5	23	14.0	0.6182	0.3818	0.0378	0.121	70–80
San-in	89	36	40.4	39	43.8	14	15.8	0.6236	0.3764	0.0514	0.394	50–60
San-yo	90	30	33.3	47	52.2	13	14.5	0.5944	0.4056	0.0518	0.621	40–50
Shikoku	312	146	46.8	133	42.6	33	10.6	0.6811	0.3189	0.0263	0.109	70–80
Kyushu (N)	109	55	50.4	44	40.4	10	9.2	0.7064	0.2936	0.0436	0.039	80–90
Kyushu (S)	252	112	44.4	105	41.7	35	13.9	0.6528	0.3472	0.0300	1.645	10–30
Total for Japanese	1808	798	44.1	803	44.4	207	11.5	0.6634	0.3366	0.0111	0.054	80–90
Ainu	86	44	51.2	31	36.0	11	12.8	0.6918	0.3082	0.0498	2.055	10–20
Korean	65	29	44.6	29	44.6	7	10.8	0.6692	0.3308	0.0584	0.004	<90
Ryukyuan	124	42	33.9	64	51.6	18	14.5	0.5968	0.4032	0.0436	0.650	40–50
Thai	108	21	19.5	57	52.8	30	27.8	0.4583	0.5417	0.0478	2.455	10–20

* In order from north to south.

The concentration of isoniazid was determined 6 hours after oral administration of 4 mg of isoniazid per kilogram of body weight. We classified the subjects as rapid inactivators if the concentration was equal to or less than 0.15μg/ml; intermediate if the concentration was between 0.15 and 0.8; and slow if the concentration was equal to or greater than 0.8 (*3*). We may round off 0.15 to 0.2, but in this case the concentration less than 0.2 is rapid and that equal to 0.2 is intermediate. Our family study shows that rapid and slow inactivators are homozygous, that intermediate inactivators are heterozygous, and that inactivation of isoniazid is a character that is inherited without dominance.

We studied the patterns of isoniazid metabolism of several races in the Far East and found that the more southerly the region the higher the frequencies of "slow" alleles, obtained by the maximum likelihood method (Table 1). The chasm between Eskimos (*4*) and Caucasians is bridged by Ainus, Koreans, Japanese, Ryukyuans, and Thai. If we rearrange the experimental results reported by Mitchell *et al.* (*5*), Knight *et al.* (*6*) and Levy *et al.* (*7*) on the basis of our criterion, the incidences of "slow" characters in Americans are 44.5, 45.6, and 54.5 percent and those of "rapid" are 26.8, 17.0, and 9 percent, respectively. It is noteworthy that there is a rather wide zone of intermediate inactivation also in the whites.

There are local differences in the frequencies of "slow" and "rapid" alleles in Japan and, as in the case of racial differences, frequencies of "slow" alleles increase in more southerly districts, except Shikoku and Kyushu. Hokkaido also forms an exception to the north–south pattern. Because Hokkaido was recently developed and almost all its inhabitants are immigrants from various other districts in Japan, it is natural that the frequency of the alleles in this district is nearly equal to the mean value for all Japanese. The reason Shikoku and Kyushu, which are the two most southern islands in Japan, show rather low frequencies in "slow" alleles is unknown.

Since the frequencies of both alleles are relatively high, it might be presumed that pressure of selection on the alleles is weak. Accordingly, if our genetic hypothesis is valid, Hardy-Weinberg's law might hold for all the local groups indicated in the table. The test for random mating establishes that the observed and expected values agree remarkably well. Our hypothesis that rapid and slow inactivators are homozygotes, that intermediate inactivators are heterozygotes, and that there is no dominance between alleles is, we believe, amply proved by the population genetical analysis.

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