Short Communication

Influence of After-ripening on Phytochrome Control of Seed Germination in Two Varieties of Lettuce (Lactuca sativa L.)

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ABSTRACT

The reversible photoreaction on seed germination of two varieties of lettuce differs remarkably not only with the variety but also with the germination temperature and the physiological conditions of seeds caused by after-ripening. Grand Rapids showed reversible photoreaction at 25 C with 0 to 6 months and at 30 C with 5 to 6 months after-ripening. MSU 16 did not show any reversible photoreaction at 30 C with 0 to 6 months or at 25 C with 0 to 3 months after-ripening although they were completely reversible with 4 to 6 months after-ripening. These two varieties of lettuce seeds, however, showed reversible photoreaction at 20 C when they were sown immediately after harvest or after 1 and 2 months after-ripening. The photoreversion decreased after the 4- to 6-month stage.

It is wellknown that the typical phytochrome system is involved in the germination of photosensitive lettuce seeds (1). There is, however, considerable variation between different seed stocks, which depends largely on the history of the parent plant (7) and of the seeds after harvest (4, 12).

An analysis of the relationships between the temperature and the after-ripening of seeds in phytochrome-mediated germination was not made. We studied the functioning of the phytochrome system in lettuce seed germination at different temperatures, using the seeds of two varieties in 0 to 6 months after-ripening.

MATERIALS AND METHODS

Lettuce plants (Lactuca sativa L. cv. Grand Rapids and MSU 16) were grown in the greenhouse of Fukushima University in 1977. Seeds were harvested from the mother plants about 20 days after anthesis. Harvested seeds were air-dried and kept in paper bags in a wooden box at room temperature (23 ± 2 C) until used. This storage constituted the after-ripening treatment. Fifty seeds were sown on two layers of Toyo No. 3 filter paper moistened with 1 ml distilled H2O in a 4-cm diameter Petri dish. The dishes then were wrapped with a light-proof paper, which was removed when irradiation was given. These dishes were placed in temperature-controlled chambers (±1 C).

R (660 nm) and FR (730 nm) light were obtained by biological spectograph (9) and light intensity at the level of seeds was adjusted to 3,000 ergs cm-2 s-1 for both R and FR.

The per cent germination was determined 48 h after sowing and is expressed as an average of four dishes ± the standard error.

RESULTS

Seeds of both varieties of lettuce showed phytochrome control of germination at 20 C when they were sown immediately after harvest or with 1 and 2 months after-ripening (Table I). Their reversibility, however, began to decrease gradually with 2 to 3 months after-ripening. Neither Grand Rapids nor MSU 16 seeds showed any reversibility with after-ripening for 4 to 6 months. This is because both varieties germinated 88 to 76 % in darkness or under 5 min FR irradiation.

Grand Rapids seeds were completely reversible at 25 C with 0 to 6 months of after-ripening and at 30 C with 5 to 6 months of after-ripening (Table I). MSU 16 was completely reversible at 25 C with 4 to 6 months after-ripening.

Grand Rapids did not show any reversibility at 30 C with 0 to 4 months after-ripening and MSU 16 did not show it, either, at 25 C with 1 to 3 months after-ripening. This is because both varieties were dormant and were not induced to germinate by 5-min exposure to R light at each temperature.

DISCUSSION

Grand Rapids seeds lose their thermal dormancy when after-ripened for 5 to 6 months. Early during thermal dormancy, they are photoreversible. Later, they lose photoreversibility and lose thermal dormancy. These losses occur during after-ripening and seeds become nondormant and germinate over a broad range of temperature in the dark. MSU 16 was more thermal dormant to begin with and was generally more dormant than Grand Rapids seeds throughout after-ripening.

The response of seeds toward R and FR light is influenced by germination temperature and other factors (2, 4, 6, 8, 11–14). Our data indicate that the function of phytochrome is influenced markedly not only by germination temperature but also by after-ripening.

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1 This work was supported by a grant from the Japan Society for the Promotion of Science.
2 Present address: Fukushima University, Matsukawa-Machi, Fukushima, 960-12, Japan.
3 Original seeds were obtained from G. J. Ball.
4 Original seeds were obtained from S. Homma, Michigan State University.

5 Abbreviations: R, red; FR, far red.
The failure of seed germination is reversible and controllable. The physiological control of seed germination is important in understanding seed development and dormancy. The germination of lettuce seeds is generally controlled by temperature and light. Germination of lettuce seeds is not significantly affected by the germination light requirement. The results of this study showed that the germination of lettuce seeds is not significantly affected by the germination light requirement. The results of this study showed that the germination of lettuce seeds is not significantly affected by the germination light requirement. The results of this study showed that the germination of lettuce seeds is not significantly affected by the germination light requirement. The results of this study showed that the germination of lettuce seeds is not significantly affected by the germination light requirement. 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