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Heat stimulation for the mesocotyl elongation in paddy rice plants, *O. sativa* L. in japonica type

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For the seedling-emergence in cereals, mesocotyl elongation seems to be much favouring character.³⁾ In paddy rice plants, *O. sativa* L., it is reported by Hamada¹⁾ that the mesocotyl elongation in darkness is little in japonica type and much in indica type.

An attempt to elongate the mesocotyl of paddy rice plants in japonica type made in this laboratory are reported here.

Materials and methods

The materials used in the present experiment were seven normal varieties and two dwarf varieties of paddy rice in japonica type, and two normal varieties of paddy rice in indica type.

To obtain uniform growth, well matured seeds of medium size were selected. After husking, the rice seeds were sterilized by immersing in 80 % alcohol for 30 seconds, then in 0.2 % solution of corrosive sublimate for 2 minutes and finally washed with sterilized water,

About 25 ml of culture medium containing modified White's minerals²⁾ and 0.6 % agar was placed in test tube, 18×180 mm, and autoclaved at 1.0 kg/cm² overpressure for 5 minutes. The sterilized seeds were sown in the hot culture medium of about 90°C. Immediately after sowing, the test tubes were cooled with running tap water. Hereupon, the seeds received heat of the culture medium for the duration when they went down from the surface to the bottom of the culture medium, and the medium became solid (Fig. 1). In this method, the sown seeds lay at the bottom of the test tubes. After becoming solid of the medium, the test tubes were reversed upside down, and 4 ml of oxygen gas and 16 ml of nitrogen gas were put into the test tube along the wall of the tube with an injector. So, each tube contained one seed, 20 ml of the mixing gas and about 15 ml of the

culture medium. Oxygen concentration was about 20 % in this experiment. Growth of plumules occurred in this mixing gas. In order to prevent the culture medium from drying, these tubes were kept standing in culture solution and transferred to darkness at 30°C.

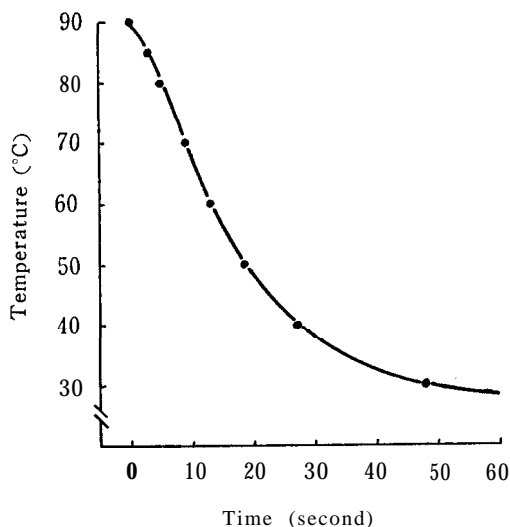


Fig. 1. Drop in temperature of the hot culture medium after sowing at the bottom of the tubes in running tap water.

Results and discussion

After 12 days from sowing, length of mesocotyl, coleoptile and seminal root were examined (Table 1, Fig. 2).

From Table 1, mesocotyl elongation was stimulated by heat treatment in all treated rice varieties, though the stimulation was not completely effective for all the treated plants. As to the plants which were stimulated the mesocotyl elongation by heat treatment, stimulation rate was a little greater in normal variety group than in two dwarf varieties in japonica type; the former was 7-51 times and the latter was 10-12 times as compared with the control. In indica type of two normal varieties, the stimulation rate was the least; it was only 2-3 times as compared with the control. On the other hand, total length of mesocotyl was the longest in indica type, and it was almost the same in normal and dwarf varieties in japonica type. The heat treatment, however, seems to have inhibitive effect on the elongation of coleoptile and seminal root. Sometimes, greater part of the treated rice seeds died or could not grow in indica type.

Table 1. Heat stimulation for the mesocotyl elongation in paddy rice plants.

Type	Varieties	Control plants		Treated plants		Stimulation rate (B)/(A)
		No. of plants	Length of mesocotyl (A) (mm)	No. of plants*	Length of mesocotyl (B) (mm)	
Japonica (normal)	Akebono	10	2± 0.7	4 (3)	29± 16.7 5± 2.2	15
	Kusabue	10	2± 0.6	6 (2)	26± 13.9 4± 2.8	13
	Yamabiko	9	2± 0.1	2 (6)	14± 2.8 4± 1.6	7
	Kinmaze	10	3± 0.1	4 (2)	45± 22.4 7± 1.0	15
	Ariake	10	3± 1.0	6 (3)	24± 5.6 5± 2.6	8
	Hoyoku	10	1± 0.3	3 (11)	32± 11.7 3± 2.3	32
	Nōrin No. 18	10	1± 0.7	1 (9)	51± 0.0 3± 0.1	51
Japonica (dwarf)	Daikoku	10	3± 0.1	1 (7)	36± 0.0 3± 3.0	12
	Tan-ginbozu	9	3± 0.9	2 (4)	30± 28.0 4± 1.4	10
Indica (normal)	Salipe	5	17± 7.2	1 (1)	36± 0.0 2± 0.9	2
	Kumari	9	30± 14.5	1 ()	95± 0.0 2± 0.0	3

* Number of plants which elongated mesocotyl less than 10 mm long is enclosed in parenthesis.

It is likely that the stimulation of the mesocotyl elongation by heat treatment is attributed to the activation of gibberellic acid.^{4,5)} The sterilized seeds were dried in a desiccator under reduced pressure for about 2 hours. The dried seeds were immersed in GA₃ solution, or in the water for the control, for 24 hours at 5°C. After these treatments, the treated seeds were sown in the culture medium of about 50°C. After 12 days from sowing, length of mesocotyl, coleoptile and seminal root were examined (Table 2).

From Table 2, the mesocotyl elongation in japonica type was stimulated with GA₃ treatment at high concentration (100, 500 and 1,000 ppm), but not at low concentration (0.1 and 10 ppm). The length of mesocotyl increased with the concentration of GA₃. In this case, the stimulation rate of mesocotyl elongation in GA₃ treatment of 1,000 ppm was as same as that in heat treatment. The action of the former was almost the same with that of the latter. That is, the mesocotyl elongation was fairly stimulated in a part of treated plants but it was

stimulated a little in the other. In the stimulated plants with GA_3 treatment, growth of coleoptile and seminal root were inhibited to some extent.

From the above results, it is postulated that the stimulation of mesocotyl elongation in rice plants by heat treatment of seeds may be attributed to the activation of GA, in the seeds by heat treatment.

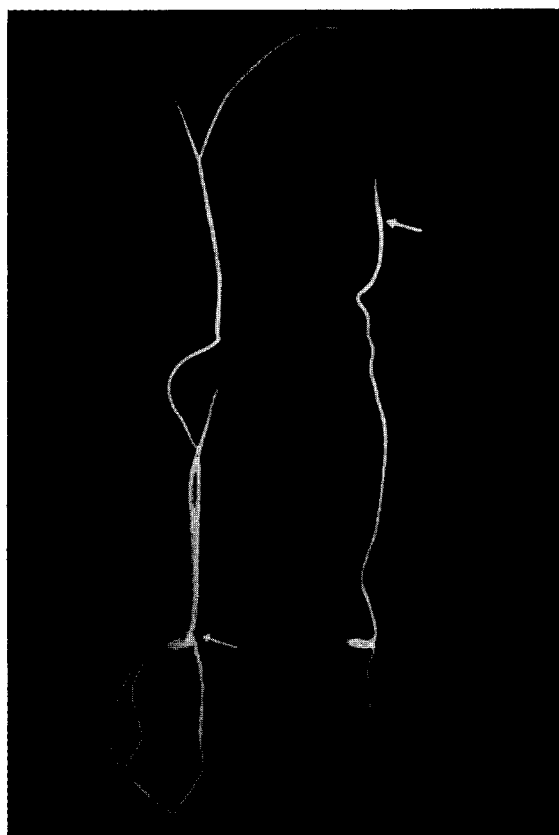


Fig. 2. Heat stimulation for mesocotyl elongation in a normal variety, Hoyoku, of paddy rice plants in japonica type. After 12 days from sowing at 30°C in darkness. (Left; control plant. Right; treated plant. ↙; node of coleoptile)

Table 2. Effect of GA₃ on the mesocotyl elongation in a normal variety in paddy rice plants in japonica type (Hoyoku, after 12 days from sowing, at 30°C in darkness).

Concentration of GA ₃ (ppm)	No. of plants	Length of mesocotyl (mm)
0	10	1± 0.3
0.1	9	1± 0.3
10	8	3± 0.9
100	(14)	20± 6.3 2± 1.2
500	4 (16)	26± 11.4 3± 2.2
1000	4 (16)	35± 12.5 4± 1.9

* Number of plants which elongated mesocotyl less than 10 mm long is enclosed in parenthesis.

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