SOME TEMPERATURE RELATIONS OF GEOTROPISM

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Relatively few investigators have made quantitative studies of the effects of varying temperatures upon the presentation and latent times of plant tropisms. The principal investigations have been those of Czapek (1898), Rutgers (1912), and Hawker (1933).

In the present work are described experiments designed to investigate the effects of various temperatures upon geotropic latent and presentation times of three species of plants: *Lathyrus odoratus* L. epicotyls, *Zeamays* L. coleoptiles, and *Vicia faba* L. hypocotyls and to determine the relationship of such effects to the age of the plants studied. The experiments were carried out in a room darkened except for a phototropically-inactive red light, in constant-temperature cases designed by Prof. C. F. Hottes. Seedlings were grown in wet sawdust in 2-inch pots. In all cases, the seedlings were grown at room temperature (20°-22°C.) until they were ready for testing. They were then placed in the temperature cases in which they were allowed to remain for 24 hours before being subjected to gravitational stimulus. The presentation and latent times were determined following stimulation by means of observation with a horizontal microscope.

Table I shows the results of experiments upon the effects of various temperatures upon the geotropic presentation and latent times of the species investigated. In the table, PT and LT indicate respectively presentation and latent time. The lengths of the aerial portions of the plants are indicated after the names of the plants. Each figure represents an average of ten determinations.

Table II shows the temperature coefficients calculated from the data of Table I. Coefficients are shown only for the temperature ranges which showed increased sensitivity, i. e., lowered presentation and latent times.

Table III shows the presentation times of coleoptiles of *Zea mays* and epicotyls of *Lathyrus odoratus* of different ages at various temperatures.

The results and conclusions of the above experiments are the following:

1. The geotropic presentation and latent times of the plants studied vary markedly with temperature changes. In *Zea mays* and *Lathyrus odoratus* the greatest sensitivities, as indicated by the shortest presentation and latent times, are those at 30°C. In *Vicia faba*, the presentation and latent times are of approximately equal value at 25° and 30°C, the range of greatest sensitivity.

2. In the plants studied, the presentation times vary to a greater extent with changing temperatures than do the latent times. These differences in the relative sensitivity of presentation and latent times are shown by the temperature coefficients in Table II.

3. Geotropic sensitivity, as indicated by variations in presentation times at different temperatures; varies with the ages of the seedlings. In *Zea mays*, the greatest sensitivity occurs when the coleoptiles are approximately 3 cm. tall. In *Lathyrus odoratus*, the greatest sensitivity occurs, in most of the temperatures used, at an epicotyl length of approximately 8 cm. This is in agreement with the results of Hawker (1933).

4. It is suggested that, in the study of such complex phenomena as tropisms, attempts to apply the van't Hoff law should not be regarded seriously as indicating the nature of the processes involved. As is shown in Table II, there is considerable variation in the Q_{10} values in the different species and at different temperatures. Because of such variations and because of the obviously complex nature of tropisms, it seems unwise to interpret these reactions upon the same basis as would be employed for the study of relatively simple physical or chemical reactions.

TABLE I.—PRESENTATION AND LATENT TIMES IN MINUTES AT VARIOUS TEMPERATURES

Temp.	*Zeamays* (3 cm.)		*Lathyrus odoratus* (5 cm.)		*Vicia faba* (6 cm.)	
	PT	LT	PT	LT	PT	LT
5°C	51	104	61	90	51	140
10°	26	73	45	62	32	96
15°	17	50	28	48	19	68
20°	10	44	18	38	9	52
25°	8	37	9	31	6	46
30°	5	31	6	28	6	48
35°	6	41	11	41	12	58
40°	28	74	28	55		

TABLE II.—TEMPERATURE COEFFICIENTS FROM DATA OF TABLE I

Temp. ranges	*Zeamays*		*Lathyrus odoratus*		*Vicia faba*	
	PT	LT	PT	LT	PT	LT
5°—15°	3.00	2.08	2.17	1.87	2.68	2.05
10°—20°	2.60	1.65	2.50	1.63	3.44	1.84
15°—25°	2.13	1.35	2.44	1.54	3.16	1.47
20°—30°	2.00	1.41	3.00	1.35	1.50	1.08
25°—35°	1.33					

TABLE III.—PRESENTATION TIMES OF SEEDLINGS OF DIFFERENT AGES AT VARIOUS TEMPERATURES

A. *Lathyrus odoratus*

Length of epicotyl	5°C.	10°	15°	20°	25°	30°	35°	40°
1 cm	68min.	49	36	22	18	17	20	33
3 cm	60	41	28	18	16	10	16	29
5 cm	58	42	26	17	10	8	10	23
8 cm	60	35	18	11	10	7	12	20
10 cm	65	43	24	17	12	8	13	25

B. *Zeamays*

Length of coleoptile								
1 cm	61	40	26	20	13	12	16	38
2 cm	56	34	20	12	10	8	12	39
3 cm	53	29	19	11	9	6	8	31
5 cm	58	33	27	17	14	11	12	32

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