A SURVEY OF THE EFFECT OF GENETICS AND TEMPERATURE OF GERMINATION ON LENGTHS OF THE FIRST AND SECOND INTERNODES OF ETIOLATED PEA SEEDLINGS

Seguin, S. and C. Nozzolillo Department of Biology
University of Ottawa, Canada

Germinating seeds of Pisum sativum buried at varying depths in the soil will elongate until they reach the surface. Light is the important factor influencing elongation. In fact, if no light reaches the seedling, it will elongate until all food reserves in the cotyledons are utilized or even cease before complete depletion has occurred (1). This phenomenon, etiolation, is characterized by a very rapid stem elongation and by the suppression of leaf expansion (2). A survey of 34 Weibullsholm lines* was made to assess the extent to which genetic differences might affect etiolation.

The experimental procedure was as follows: The seeds were surface-sterilized with a 20% solution of sodium hypochlorite (Javex) for 5 minutes, then rinsed well. Following imbibition in distilled water for 24 hrs in darkness at 15±1 C, the seeds were placed on a shallow layer of heat-pasteurized, moistened sand in aluminium soil moisture cans (diam 9.0 cm). Each can was covered with a 48-oz Juice can (diam 10.5 cm. ht 17.5 cm) to prevent light penetration, and put in a temperature-controlled (15±1 C) growth chamber. After two weeks, seedling development was checked using a dim green safety light [a small amount of green light has no significant effect on the growth of dark-grown seedlings (1)]. Those with fully developed first and second nodes were removed and measured. All. others were allowed to continue their development and were checked each following week until all the germinated seedlings had reached the appropriate stage of development.

The effects of temperature on etiolation were examined with two of the Weibullsholm lines (WL-1451, WL-267) chosen because of the differences shown in their internodal lengths at 15 C and their fairly high germination percentage. The experiments (imbibition and growth) were done in growth chambers where the temperature was maintained at 5, 10, 20, 25, and 30 C respectively.

The results of the survey, expressed as mean value + standard deviation, are summarized in Table 1. There was wide variation among lines, and lengths bear little or no relationship to whether the lines were "dwarf" or "tall" when grown in light. Some lines (eg. 58, 369, 1088, 1267, 1366, 1391 , 1508) had very short internodes while others (eg. 1415, 1416, 1451 , 1467, 1570, 1754) had much longer internodes. The relationship between the first and second internode varied also. The two were almost the same length In some lines (eg. 58, 1570); in others they were very different. For example, lines 5 and 1227 had a longer first internode while in lines 1415, 1416, 1545, and 1614 the second internode was longer.

•Courtesy of S. Blixt.

Table 1. Lengths of the first[1/] and second internode in different lines of etiolatead peas grown at 15°C in darkness.

Line No.	Status of Le locus according to Blixt (1964)	Length of the 1st internode ± S.D. mm	Length of the 2nd internode ± S.D. mm	No. of specimens
5	le	46 ± 14	26 ± 12	8
25	+	52 ± 17	56 ± 11	7
58	+	19 ± 4	19 ± 2	8
59	+	28 ± 5	35 ± 8	9
369	le	28 ± 9	18 ± 6	3
565	+	28 ± 13	22 ± 3	7
577	le	26 ± 9	18 ± 4	6
582	+	30 ± 7	32 ± 5	11
1073	le	39 ± 3	39 ± 9	5
1088	le	33 ± 11	24 ± 6	10
1227	+	42 ± 9	16 ± 4	2
1238	le	31 ± 7	39 ± 10	5
1241	+	52 ± 10	54 ± 11	11
1267	+	21 ± 6	26 ± 9	14
1366	le	24 ± 11	36 ± 7	4
1369	le	31 ± 8	50 ± 14	14
1391	le	46 + 7	29 ± 7	4
1402	le?	60 ± 12	63 ± 14	11
1415	+	67 ± 8	72 ± 12	15
1416	+?	63 ± 12	86 ± 11	15
1422	+	63 ± 10	81 ± 14	15
1433	+?	64 ± 12	84 ± 9	15
1451	le	69 ± 8	57 ± 8	10
1458	+	45 ± 9	44 ± 10	12
1464	+	42 ± 7	58 ± 18	13
1467	+	50 ± 13	75 ± 14	11
1503	+	32 ± 12	39 ± 10	11
1508	le	17 ± 4	24 ± 3	3
1520	le	54 ± 12	42 ± 22	6
1521	+	35 ± 4	25 ± 5	3
1545		22 ± 8	54 ± 12	3
1570		59 ± 11	59 ± 11	9
1614		32 ± 6	64 ± 7	14
1754		80 ± 7	74 ± 10	15

[1/] First internode is the distance between the cotyledons and the first scale leaf.

x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x
x Editor's Note: Information in the "Status of the Le locus" column
x in Table 1 was inserted by the Editor without first consulting
x the authors. The information was extracted from "A presentation
x of the Lamprechtian Pisum material" (Second, revised and extended
x edition); Edited by S. Blixt; Weibullsholm Plant Breeding Insti-
x tution, Sweden; Report from the Institute, November 1964.
x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x x >

Line 1267 and line 1451 were submitted to the temperature experiments. The seeds germinated at 5 C, but growth was so slow that the experiment at this temperature was abandoned after 3 weeks. There was a significant difference between the internodal length of groups at different temperatures. The internodal lengths of both lines are summarized in Tables 2 and 3. These values were plotted on graphs of the internodal length versus temperature (Fig. 1 and Fig. 2). A minimum length occurred at 15 C for line 1267 for both the first internoge and the second internode. For line 1451. the minimum was found at 20 C and the values (45, 45) were higher than the minimal values of line 1267 (21, 26).

Table 2. Internodal lengths in pea seedlings grown in darkness at various temperatures. Line 1267.

Temperature ± 1°C	1st internodal length ± S.D. mm	2nd internodal length ± S.D. mm	Number of specimens
10	61 ± 14	62 ± 20	13
15	21 ± 6	27 ± 9	14
20	44 ± 10	49 ± 18	13
25	41 ± 6	49 ± 10	13
30	53 ± 6	70 ± 16	8

Table 3. Internodal lengths of pea seedlings grown in darkness at various temperatures. Line 1451.

Temperature ± 1°C	1st internodal length ± S.D. mm	2nd internodal length ± S.D. mm	Number of specimens
10	88 ± 12	80 ± 10	10
15	69 ± 8	57 ± 8	10
20	45 ± 3	45 ± 12	6
25	59 ± 9	70 ± 16	10
30	72 ± 13	77 ± 10	7

1. Low, V.H.K. 1971. Effects of light and darkness on the growth of peas. Aust. J. Biol. Sci. 24:187-195.
2. McComb, A. J. 1977. Control of root and shoot development. In: The Physiology of the Garden Pea. Eds. J. F. Sutcliffe and J. S. Pate. Academic Press, New York, 235-263.

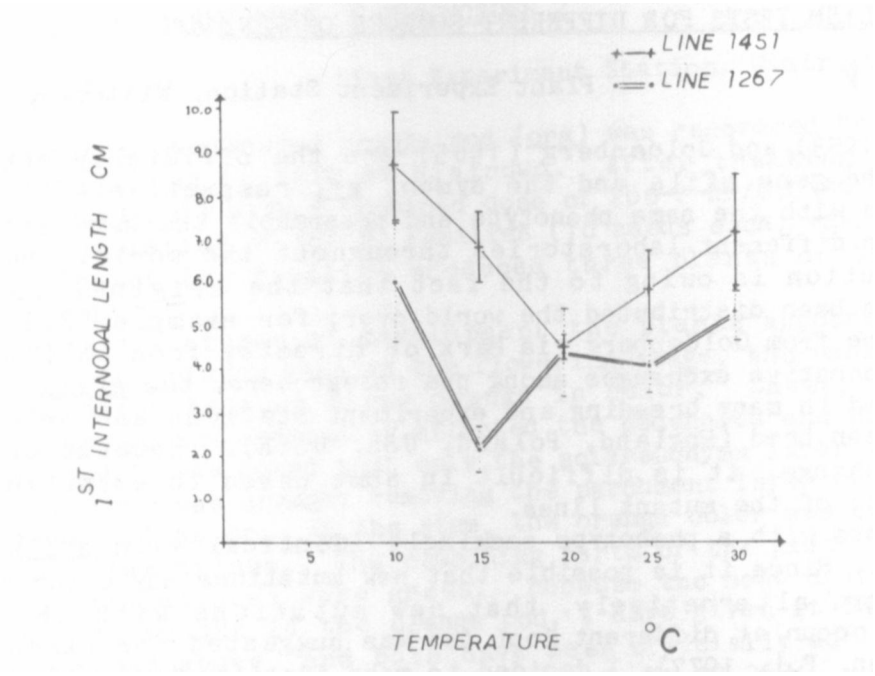

Fig. 1. Effect of the temperature on the first internodal length in two different lines of pea; vertical bars represent the standard deviation.

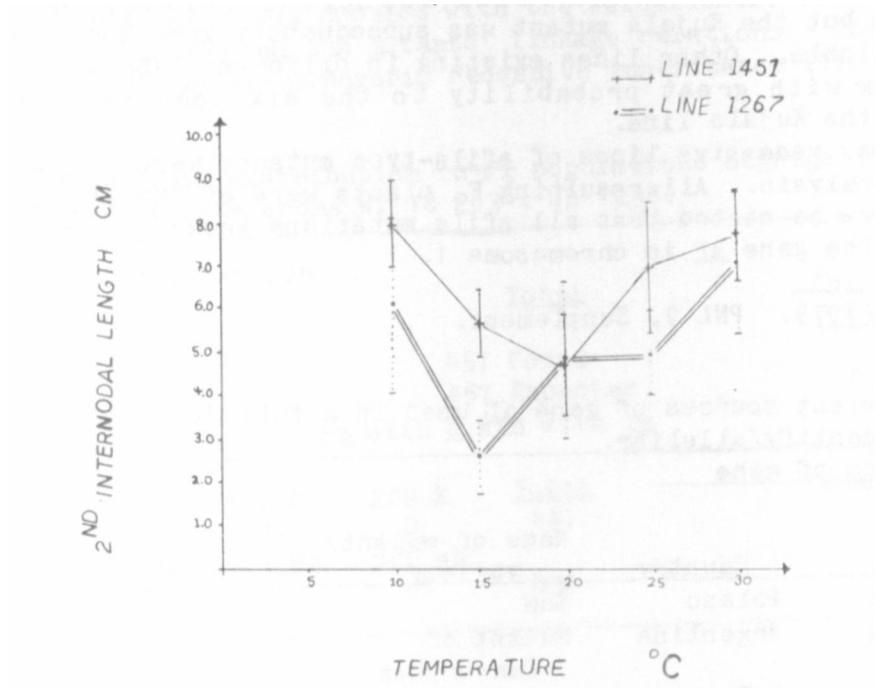

Fig. 2. Effect of the temperature on the second internodal length in two different lines of pea; vertical bars represent the standard deviation.