Response of the Fern *Woodsia obtusa* (Spreng.) Torr. to Temperature and Day Length

F. Stearns and S. N. Postlethwait, Purdue University

Introduction and Methods

Mosses, liverworts, and ferns offer an excellent opportunity to study the influence of environmental factors as they effect both the sporophytic and gametophytic generations. To date most investigations have dealt with flowering plants, bacteria, fungi, or algae (Audus, 1953). Studies on the influence of temperature and photoperiod on mosses and ferns are presently in progress using the controlled climate facilities provided in the new Plant and Soil Laboratory at Purdue University. This report includes the results of a preliminary study involving the sporophyte of the fern *Woodsia obtusa* (Spreng.) Torr.

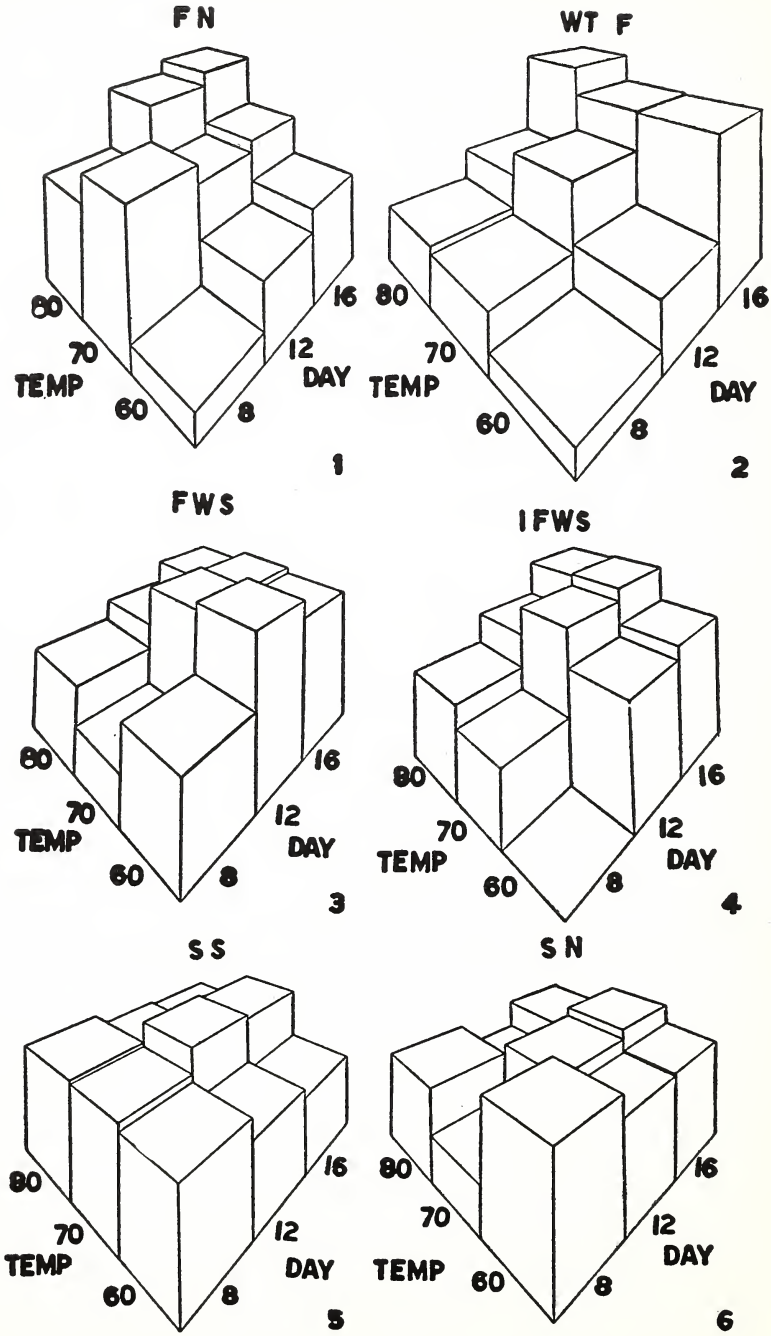
Rhizomes of the fern *Woodsia obtusa* (Spreng.) Torr. obtained near Lafayette, Indiana, on May 1, 1954 were transplanted to flats which were then placed under controlled conditions. These consisted of all possible combinations of 60°F., 70°F., 80°F. temperatures with 8 hr., 12 hr., and 16 hr. photoperiods. Fronds were clipped back in all flats on May 22nd. The plants were then allowed to continue growth under controlled conditions until August 6th, at which time fronds were again clipped and the following observations made: The total number of fronds per treatment; the total weight of fronds per treatment; the percentage of mature fronds bearing spores; the percentage of immature fronds bearing spores, the relative number of sori per frond. Numerical data are presented in Table I.

Results and Discussion

Frond number—The number of fronds produced appeared to be influenced by both light and temperature. The greatest number of fronds were observed under the 80°-16 hr. light treatment (fig. 1). Production dropped off progressively with decreasing temperature and decreasing day length.

Total dry weight of fronds—The dry weight of fronds seemed to be more closely correlated to light than to temperature (fig. 2). The dry weight of the fronds grown under 80°-16 hr. treatment was greater than under any other condition. Progressive decrease in weight accompanied decrease in day length for each temperature treatment but only slight variation occurred with variation of temperature in the day length series.

Mature fronds with sori—The percentage of mature fronds bearing sori decreased with decreasing day length (fig. 3). Variation in temperature did not appreciably influence the number of fronds bearing sori. However, the plants in these experiments may have retained some of their earlier induction from the field. Some substantiation of this is provided by data on immature fronds bearing sori. The percentage of immature fronds bearing sori (fig. 4) displayed a closer relation to day length. Experiments now in progress in which the plants have been subjected to 3 weeks of near 0°F. and then returned to controlled temperature and light conditions show abundant production of sori at 16 hour days, little at 12 hour days, and none at 8 hour days.


FN
80
70
TEMP
60
8
12
DAY
16
1
WT F
80
70
TEMP
60
8
12
DAY
16
2
FWS
80
70
TEMP
60
8
12
DAY
16
3
IFWS
80
70
TEMP
60
8
12
DAY
16
4
SS
80
70
TEMP
60
8
12
DAY
16
5
SN
80
70
TEMP
60
8
12
DAY
16
6

Sorus size—The relative size of the individual sorus (fig. 5) declined slightly with increasing day length. Temperature apparently had no influence.

Sori number per frond—The relative number of sori per frond (fig. 6) varied among treatments with no evident correlation with either temperature or day length. This suggests that induction is a qualitative and not a quantitative mechanism insofar as the individual frond is concerned.

Natural production of sori in *Woodsia obtusa* occurs in mid-summer (Tryon et al. 1940), further evidence that this fern is a long day plant.

TABLE I

Observations on growth and sporulation in *Woodsia obtusa* (Spreng.) Torr. grown under controlled climate conditions.

Day length in hrs.	Temp. F.°	No. of fronds	Dry wt. of fronds (gms.)	% of mature fronds with sori	% immature fronds with sori	Sorus size value (0-10)[1]	Sori number per frond values (0-10)[1]
16	60	51	10.1	80.5	73.6	4.6	6.1
12	60	39	3.7	90.0	66.7	4.9	6.0
8	60	14	1.3	50.0	0.0	6.1	7.1
16	70	76	10.4	84.0	96.1	7.9	7.3
12	70	70	7.7	86.1	88.8	8.1	6.8
8	70	80	3.3	25.0	38.4	6.5	2.6
16	80	114	13.0	78.7	94.7	6.0	5.8
12	80	103	6.1	63.7	71.1	6.0	4.2
8	80	64	3.6	48.7	52.1	6.7	5.4

1. Arbitrary values established by visual estimation.

Summary

Woodsia obtusa (Spreng.) was studied under controlled conditions of temperature and day length. It was found that both factors influence the total number of fronds produced while the dry weight is more directly

Explanation of Figures

General: Figures are three dimensional graphs showing the influence of temperature and day length in different combinations. Refer to Table I for numerical data.

Figure 1. The effect of day length and temperature on frond number.

Figure 2. The effect of day length and temperature on dry weight of fronds.

Figure 3. The percentage of mature fronds bearing sori at various temperatures and day lengths.

Figure 4. The percentage of immature fronds bearing sori developing at different temperatures and day lengths.

Figure 5. The influence of temperature and day length on relative size of the sorus.

Figure 6. The influence of temperature and day length on the relative number of sori per frond.

influenced by day length. The percentage of fronds bearing sori is correlated with day length. A sixteen hour day is more favorable than an eight or twelve hour day for production of sori. Size and number of sori per frond is not appreciably influenced by either temperature or day length.

Literature Cited

1. AUDUS, L. J. 1953. Plant Growth Substances. Interscience Publishers, New York.
2. TRYON, R. M., N. C. FASSETT, D. W. DUNLOP, and M. E. DIEMER. 1940. The Ferns and Fern Allies of Wisconsin. Dept. of Botany, Univ. of Wis., Madison, Wis.