

**SOME EFFECTS OF THE PHOTOPERIOD
ON THE SHOOT GROWTH OF CHERRY SEEDLINGS**

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INTRODUCTION

At our Institute a great many cherry seedlings are yearly grown from seed derived from crossings and open pollination in order to produce new varieties (3). For crossings in which early ripening varieties are used as seed parents, embryo cultures are vitally necessary for the production of seedlings. However, a number of plants thus grown show dwarfed growth. This is a phenomenon often described in the literature, but its exact cause is not known (1). A better knowledge of the influence of environmental factors on the growth and development of cherry seedlings might be of importance in solving this problem.

Moreover the fruit breeder is handicapped by the fact that his seedlings start fruiting only after a considerable length of time due to the existence of a juvenile phase i.e. the period between the germination of the seed and the moment at which flower initiation is possible. This phase might be shortened by using embryo-cultures (1), thus eliminating the period of stratification, or by enabling the seedlings to complete more than one growth cycle per year (4, 5) or both. Here, too, it may be of importance to know the influence of environmental conditions. From the literature it is known that the photoperiod is an important factor in the annual cycle of growth in woody plants, but little is known about fruit-trees (8). Therefore experiments on the influence of the photoperiod on the growth and development of cherry seedlings were started. In this paper some of the results so far obtained will be reported and discussed.

MATERIAL AND METHODS

First- and second-year cherry seedlings of Limburgse Boskriek (*P. avium* L.) served as test plants. They were grown from seed supplied by the Netherlands General Inspection Service for Arboriculture (N.A.K.-B.).

The experiments were carried out in the phytotron of our Institute. For details of the equipment the reader is referred to a paper by BRAAK and SMEETS (2). In all experiments the plants received every day 8 hrs. basic illumination consisting of daylight given in a glasshouse from 8 a.m. till 4 p.m. Next the plants, which were placed on trolleys, were moved to air-conditioned rooms where they were either placed in darkness or received additional illumination consisting of 8 or 16 hrs. incandescent light. At 8 a.m. the following morning the plants were transferred again to the glasshouse, and so on. The radiant energy of the additional incandescent light between 4,000 and 7,200 Å at the tip of the plants was about 1,200 mW/m². The plants were grown at a constant temperature of 20°C during day and night. In general the maximum deviation from the mean temperature was 1°C in the glasshouse, ½°C in the air-con-

SOME EFFECTS OF THE PHOTOPERIOD ON CHERRY SEEDLINGS

ditioned rooms. Only on exceptionally hot days did the temperature rise in the 20°C glasshouse to 25°C in the afternoon.

EXPERIMENTAL RESULTS

Effect of the photoperiod on first-year seedlings

In a preliminary experiment the influence of 8 and 16-hr. photoperiods on the cessation of the shoot growth of first-year seedlings was studied. The seed was stratified on September 3, 1952, sown on December 2, 1952, in seed-trays which were placed in a coldhouse. The young seedlings were pricked off in pots on March 12, 1953. The experiments were started on March 30, 1953.

It appeared that under an 8-hr. photoperiod shoot growth ceased in a number of plants at about the middle of June. At the end of June nearly all plants grown under an 8-hr. photoperiod had terminated growth. At about that time a number of plants grown under a 16-hr. photoperiod also ceased growth. However, some of these plants resumed growth after some time and terminated growth at the end of September, together with the plants that had been growing more or less continuously.

The experiment was repeated in 1954. The seed was stratified on September 30, 1953, and sown in seed-trays on December 29, 1953, which were placed in a coldhouse. The young seedlings were pricked off in pots on April 2, 1954. The experiment was started on May 19, 1954.

Table 1 shows that a large number of plants under both 8 and 16-hr. photoperiods ceased growth at the same time. However, some of the plants under an 8-hr. photoperiod ceased growth much sooner, while some of the plants under a 16-hr. photoperiod ceased growth considerably later. The latter consisted both of plants which grew more or less continuously and of plants which interrupted their growth for some time.

TABLE 1. EFFECT OF AN 8 AND 16-HR. PHOTOPERIOD ON THE CESSATION OF SHOOT GROWTH IN FIRST-YEAR SEEDLINGS OF LIMBURGSE BOSKRIEK (*P. avium* L.)

Dates	8-hr. photoperiod (40 plants)		16-hr. photoperiod (37 plants)	
	Ceased	Not ceased	Ceased	Not ceased
9. 6. 54	5	35	—	—
24. 6. 54	9	31	—	—
2. 7. 54	15	25	13	24
8. 7. 54	26	14	25	12
14. 7. 54	35	5	33	4
22. 7. 54	40	—	34	3
11. 8. 54	40	—	33	4
20. 8. 54	40	—	30	7
14. 9. 54	40	—	37	—

The growth of the plants throughout the experiment is shown in Fig. 1, for both 8 and 16-hr. photoperiods. It appears that among the plants grown in an 8-hr. photoperiod those which terminated growth much earlier than the remainder only grow little. Hence their final length differs but little from the length these plants had at the moment at which the experiment was started. The other plants grown in short days also grew

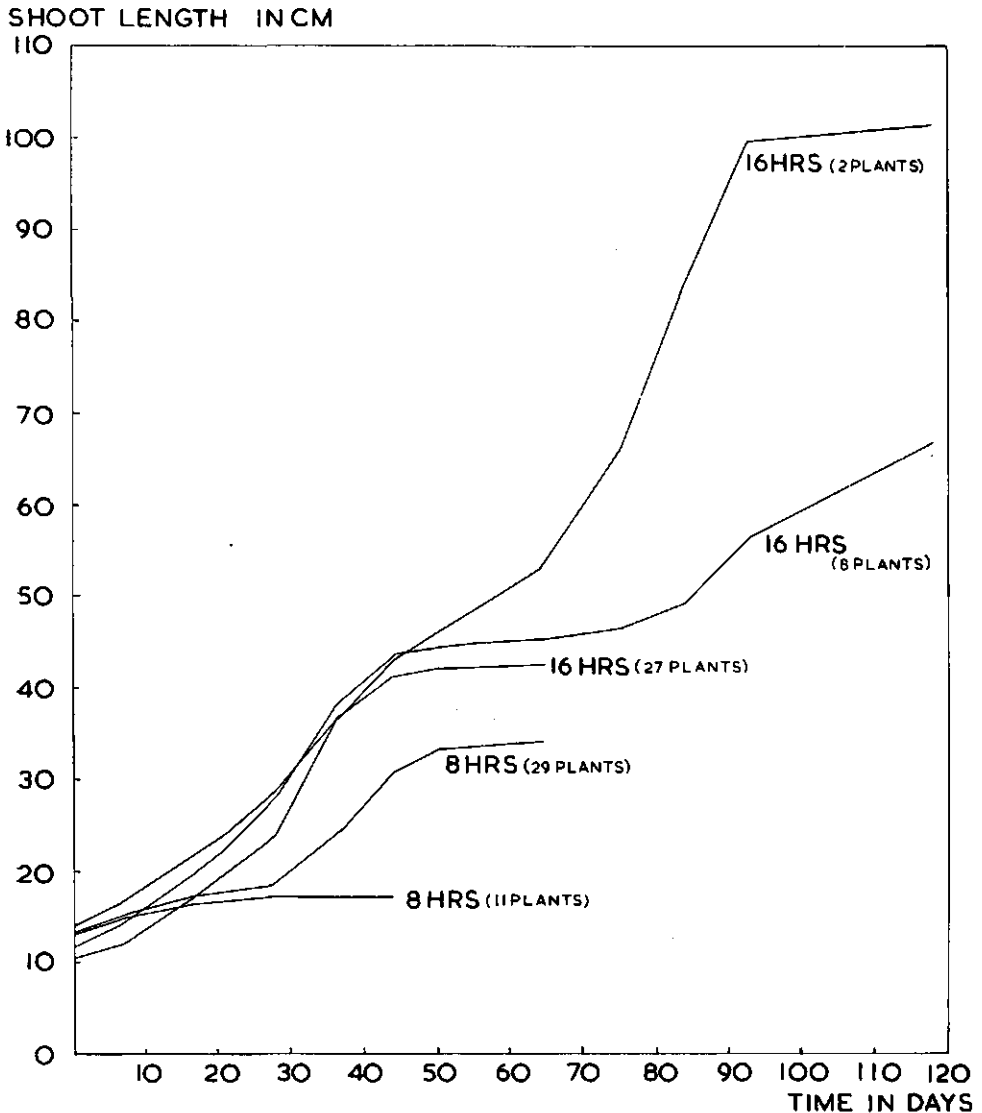


FIG. 1. THE COURSE OF GROWTH OF FIRST-YEAR SEEDLINGS OF LIMBURGSE BOSKRIEK (*P. avium* L.) UNDER 8 AND 16-HR PHOTOPERIODS FROM THE BEGINNING OF THE EXPERIMENT UNTIL THE TERMINATION OF SHOOT GROWTH. PLANT NUMBERS ARE GIVEN BETWEEN BRACKETS

little at first, but before terminating their growth they showed a period of fairly rapid development. The behaviour of the majority of the plants grown in a 16-hr. photoperiod was very similar to that of most of the plants grown in an 8-hr. photoperiod except that the initial growth of the former was more rapid. Lastly there are the plants that in a 16-hr. photoperiod terminate growth considerably later either by interrupting their growth for some time or by growing on more or less continuously. The course of growth of the

SOME EFFECTS OF THE PHOTOPERIOD ON CHERRY SEEDLINGS

former during their first growing period shows much similarity to that of the majority of the plants grown in a 16-hr. photoperiod, whereas the course of growth of the latter only does so to a smaller extent. It should be noted that the total number of plants that interrupt their growth and of those which grow on more or less continuously (Fig. 1) is larger than would appear from Table 1. This is due to the fact that the plants which interrupt their growth neither resume nor terminate growth at the same time.

Effect of the photoperiod on second-year seedlings

The first observations on the effect of 8 and 16-hr. photoperiods in second-year seedlings were made on plants already used in the preliminary experiment with first-year seedlings. In order to cause the plants to shed their leaves and to break the dormancy of their buds it was found necessary to subject the plants first to a low temperature treatment (10 weeks at a constant temperature of 6 to 7°C proved to be sufficient). After a period of fairly low temperatures in a coldhouse the plants were placed again at a constant temperature of 20°C under an 8 and 16-hr. photoperiod. The plants grown under 8 and 16-hr. photoperiods in the first year were randomly distributed between the two groups in the second year. Both groups of seedlings apparently ceased shoot growth at the same time.

In another experiment started on May 22, 1954, the influence of 8 and 16-hr. photoperiods was studied on seedlings that had been grown out of doors in 1953, and which were lifted on May 7, 1954, and then placed in 20-cm pots. They were cut back to a height of about 10 cm, while only one of the developing buds was retained on each plant. It appeared that shoot growth under 8 and 16-hr. photoperiods ceased at about the same time. The mean stem length, however, was greater under a 16-hr. than under an 8-hr. photoperiod, but the average number of leaves was only slightly higher under a 16-hr. photoperiod. A statistical analysis showed that this difference was not significant. Consequently the difference in shoot length is caused by the fact that under a 16-hr. photoperiod the internodes are longer.

Finally the influence of 8, 16 and 24-hr. photoperiods on the cessation of shoot growth was studied. First-year seedlings grown in pots out-of-doors were placed in 18-cm pots on October 6, 1955. In the first year of growth most of these plants interrupted their growth for a longer or shorter time, while some of the plants only grew

TABLE 2. EFFECT OF 8, 16 AND 24-HR. PHOTOPERIODS ON THE CESSATION OF THE SHOOT GROWTH IN SECOND-YEAR SEEDLINGS OF LIMBURGSE BOSKRIEK (*P. avium* L.)

Dates	8-hr. photoperiod (42 plants)		16-hr. photoperiod (42 plants)		24-hr. photoperiod (42 plants)	
	Ceased	Not ceased	Ceased	Not ceased	Ceased	Not ceased
6. 3. 56	9	33	7	35	5	37
13. 3. 56	24	18	25	17	17	25
20. 3. 56	39	3	38	4	33	9
27. 3. 56	40	2	40	2	37	5
4. 4. 56	40	2	41	1	40	2
27. 4. 56	42	—	41	1	42	—
17. 5. 56	42	—	42	—	42	—

during a relatively short period. They were brought indoors on January 11, 1956, and cut back to within a length of 10 cm, while only one of the developing buds was retained. The experiment was started on February 2, 1956.

Table 2 shows that even in a 24-hr. photoperiod growth ceased at about the same time as under an 8 and 16-hr. photoperiod, despite differences in the growth habits of the plants in their first year of growth mentioned above.

SHOOT LENGTH IN CM

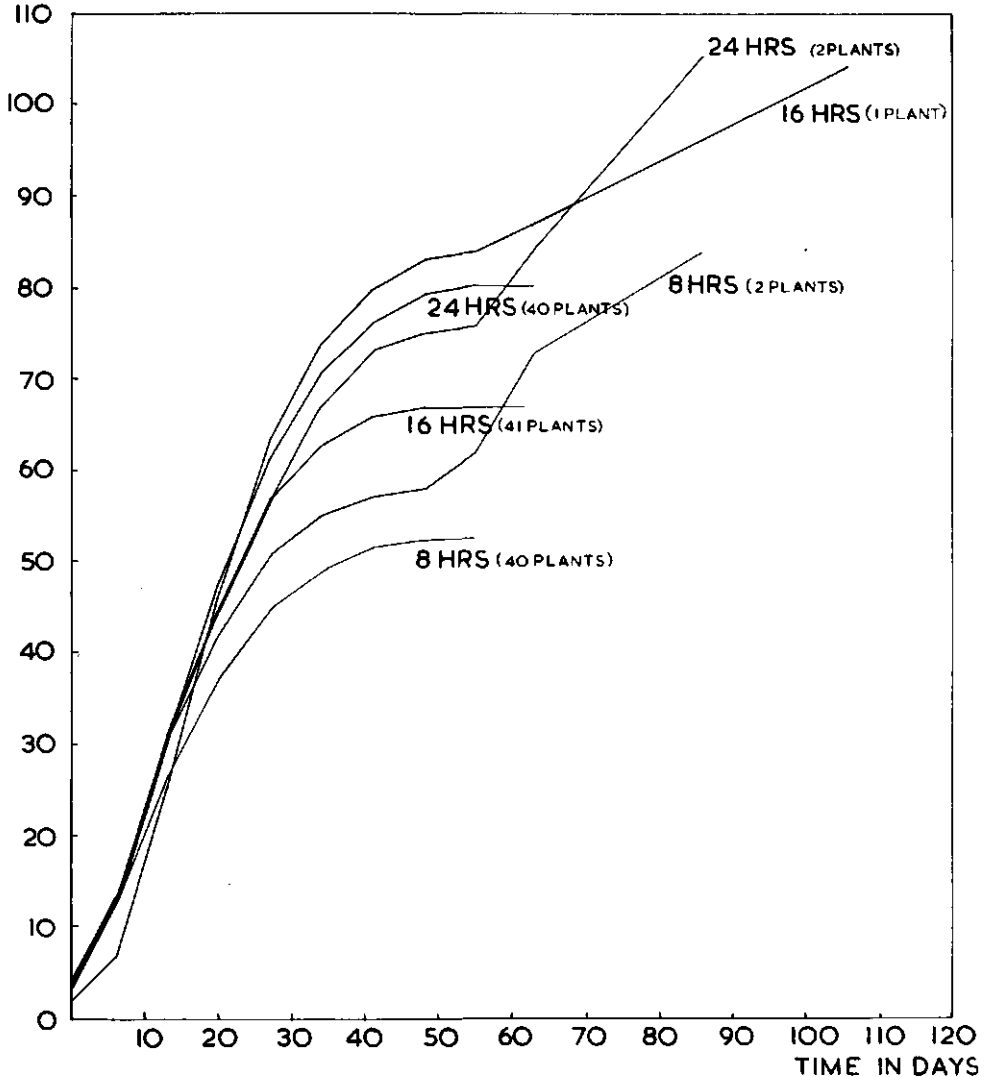


FIG. 2. THE COURSE OF GROWTH OF SECOND-YEAR SEEDLINGS OF LIMBURGSE BOSKRIEK (*P. avium* L.) UNDER 8, 16 and 24-HR PHOTOPERIODS FROM THE BEGINNING OF THE EXPERIMENT UNTIL THE TERMINATION OF SHOOT GROWTH. PLANT NUMBERS ARE GIVEN BETWEEN BRACKETS

SOME EFFECTS OF THE PHOTOPERIOD ON CHERRY SEEDLINGS

The average shoot length was greatest in a 24-hr. photoperiod while it was greater in a 16-hr. than in an 8-hr. photoperiod (Fig. 2). There was no difference in the average number of leaves under 8 and 16-hr. photoperiods (18.1 and 17.9 respectively), whereas slightly more leaves were produced under a 24-hr. photoperiod (20.0). A statistical analysis showed that this difference was significant. Consequently the difference in shoot length between the 3 treatments was mainly caused by differences in internode-length, which was longest under a 24-hr. photoperiod and longer under a 16-hr. than under an 8-hr. photoperiod.

DISCUSSION

In the previous section it was shown that under the conditions of these experiments first- and second-year cherry seedlings respond differently to the photoperiod with respect to the termination of shoot growth.

In their first year of growth many of the plants under 8 and 16-hr. photoperiods terminated growth simultaneously. However, some of the plants under an 8-hr. day terminated growth much sooner, while a number of the plants grown under a 16-hr. day terminated their growth considerably later. In the second year of growth the plants under 8 and 16-hr. days terminated their growth at about the same time.

Similar results were obtained by WAREING (6, 7) who studied the influence of the photoperiod on the growth of *Pinus silvestris*. In the first year of growth the seedlings under short days terminated their growth about 4 weeks earlier than under long days. Differences in behaviour between the plants under short or long days are not mentioned. In the second and later years growth was terminated at the same time.

These differences are explained by WAREING (7) as being due to the fact that the duration of shoot growth of first-year seedlings is not predetermined by the number of initials already laid down in the resting bud, as in second-year and older seedlings. From the results of our experiments a satisfactory explanation of the differences in behaviour between first- and second-year cherry seedlings cannot yet be given. In a following paper on the influence of the temperature this problem will be discussed further.

SUMMARY

For cherry breeding it may be of importance to know the factors affecting the growth and development of cherry seedlings. Since it is known from the literature that the photoperiod is an important factor in the annual growth cycle in woody plants, experiments on the influence of the photoperiod were started in the phytotron of our Institute.

The effect of 8 and 16-hr. photoperiods on the shoot growth of first- and second-year seedlings of Limburgse boskriek (*P. avium* L.) was studied at a constant temperature of 20°C. In one experiment the influence of a 24-hr. photoperiod in second-year seedlings was also studied.

It was found that under the conditions of these experiments first- and second-year cherry seedlings respond differently to the photoperiod as regards termination of shoot growth. In first-year seedlings many of the plants under 8 and 16-hr. photoperiods terminated their growth at the same time. However, some of the plants under an 8-hr.

photoperiod terminated growth much sooner, while a number of plants grown under a 16-hr. photoperiod terminated their growth considerably later. In second-year seedlings growth was terminated at about the same time under 8, 16 and 24-hr. photoperiods.

SAMENVATTING

Enige effecten van de daglengte op de scheutgroei van kersezaailingen

Voor het veredelingswerk bij de kers kan het van belang zijn de factoren die invloed uitoefenen op de groei en ontwikkeling van kersezaailingen nader te leren kennen. Aangezien uit de literatuur bekend is dat de daglengte een belangrijke factor is in de jaarlijkse groeicyclus van houtige planten, werd in het fyto-tron van ons Instituut een onderzoek begonnen over de invloed van de daglengte.

Onderzocht werd het effect van een korte en lange dag (8 en 16 uur) op de scheutgroei van zaailingen van Limburgse Boskriek (*P. avium* L.) in hun 1e en 2e groeijaar bij een constante temperatuur van 20°C. In één proef werd bovendien de invloed van continu licht in het 2e groeijaar bestudeerd.

Gebleden is dat onder de condities van deze proeven de zaailingen in hun 1e en 2e groeijaar verschillend reageren op de daglengte wat betreft het afsluiten van de scheutgroei. In het 1e groeijaar gaat een groot gedeelte van de planten onder korte en lange dag gelijktijdig in rust. Een deel van de planten onder korte dag gaat echter aanmerkelijk eerder in rust; een deel van de planten onder lange dag aanzienlijk later. In het 2e groeijaar gaan de planten onder korte en lange dagen en continu licht bijna alle gelijktijdig in rust.

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¹⁾ Zolang de voorraad strekt kunnen deze publikaties franco worden toegezonden, na ontvangst van het vermelde bedrag op giro no. 425340 van het Instituut voor de Verdeling van Tuinbouwgewassen, S. L. Mansholtlaan 15 te Wageningen onder vermelding van wat verlangd wordt; ook bestaat de mogelijkheid deze publikaties uit de bibliotheek van het I.V.T. te lenen.

²⁾ Eerder verschenen publikaties zijn vermeld achterin in de Mededelingen nos 1 t/m 89.