

Photoperiod and Flowering of *Pinus densiflora* Seedlings

Masaki Goo

Information on the flowering responses of coniferous species to photoperiodic conditions are very limited.

MIROV¹⁾, on the basis of the flowering records of about 35 exotic pine species, tentatively concluded that all species are neutral in their flowering response the numerous species of pines so far inspected performed neither as long-day nor as short-day plants, but as neutral plants whose flowering is not affected by the length of day.

LARSON²⁾ presented evidence to show that synchronization of climatic conditions and relative day-length with bud development may exert an influence upon flowering behavior in *Pinus banksiana*.

SKOK³⁾ observed a cone formation by an 11-month-old seedling of *Sequoia gigantea*, but it was apparently not a response to photoperiod.

From these reports the pronounced effect of photoperiod on flowering, noted in many herbaceous species, appears to be lacking in forest trees.

However, until more definitive experimental evidence be presented, photoperiod cannot be ruled out as a factor influencing flower formation.

It may be possible that the relation photoperiod and flower formation of pines becomes clearer by use of *Pinus densiflora* which form strobili in young stage as the materials of experiments as flower formation in tree is controlled not only by photoperiod but also by genetical nature.

Material and Methods

Seeds of *P. densiflora* were bought from IZUKA Company. It was sown in nursery in March 1965 and transplanted into pots in March 1966. In 18th May, potted one-year old seedlings were divided into two groups. One group of thirty-five pots was exposed to natural day-length outdoors and the other group was brought to green house. The group in the green house was divided into four series of sixteen pots each. From 27th June 1966 the four series were exposed to 8-hour, 16-hour, 24-hour and natural day-length conditions respectively. Three series (8, 16, 24-hour) were exposed to natural daylight from 8.30 a.m. to 4.30 p.m., and each series was covered with wooden box. Each box of two series (16 and 24-hour) was furnished with fluorescent daylight tubes and light intensity was 300-400 lux at plant level. The growth of winter buds was measured every month.

Results and Discussion

Table 1, shows the number of seedlings which had female strobili in early May, 1967. Male strobili was not produced in any seedlings. About two-thirds of seedlings

Table 1. Flowering response of young red pine seedlings for photoperiod.

Photoperiod		C. F.	C. G. H.	G. H. 8h.	G. H. 16h.	G. H. 24h.	Total
No. of Seedlings	♀	21	11	1	0	0	33
	No.	13	6	13	9	13	54
Total		34	17	14	9	13	87

C. F. : Natural photoperiod in field
 C. G. H. : Natural photoperiod in green house
 G. H. 8h. : 8-hour in green house
 G. H. 16h. : 16-hour in green house
 G. H. 24h. : 24-hour in green house

kept under natural day-length, both in outdoor and in greenhouse, produce female strobili, whereas these under controlled day-length produced practically no strobili. This

difference is highly significant (for X^2 test, $P < 0.01$). This different response show that the controlled day-length, either short or long-day, is disadvantageous conditions in formation of strobili. Day-light hours at Tokyo, shown in Fig. 1., are longer than 8-hour and shorter than 16-hour.

Initial stage of female strobili can be found in the bud of the mature *P. densiflora* trees from later August to middle September^{4) 5)}. As shown by Fig. 1 under long-day condition winter-buds elongated in the summer-autumn, those under 16-hour day they elongated in September, through November and under 24-hour day they elongated in September, while they did not show such an elongation under natural day-length and short-day. The elongation was far shorter

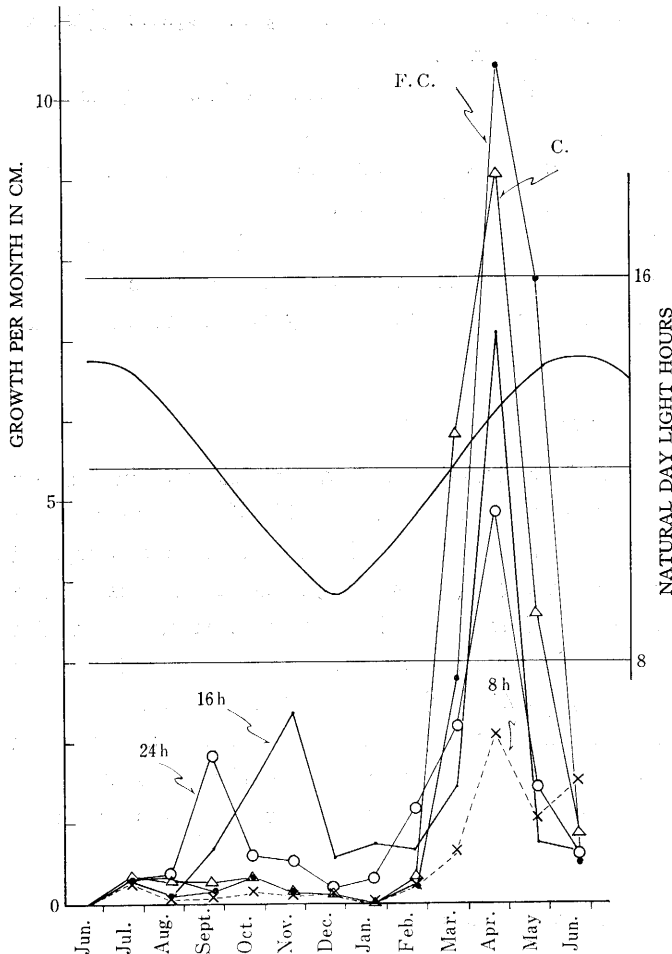


Fig. 1. Growth of the winter bud under five different photoperiods and daylight hours at Tokyo.

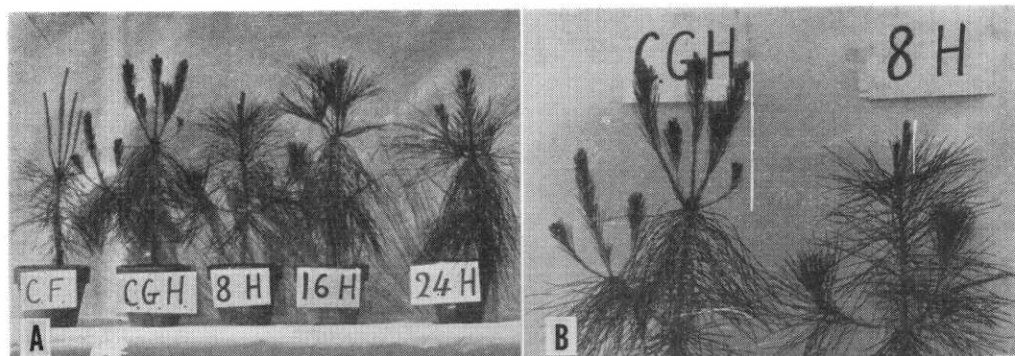


Fig. 2. (A) Seedlings of *P. densiflora* grown under five different photoperiods in 26th April 1967.
 (B) Elongation of the annual shoot under natural day-length and short-day, during from 27th June 1966 to 26th April 1967.

under short-day conditions even in spring.

If the strobili initials of the seedlings are of the same nature as in the mature trees the term of growth of the winter buds under long-day series is in accordance with the term of flower bud formation. So it seems that initiation of flower buds was inhibited and strobili initials were transformed into dwarf-shoot initial by long-day treatment.

Growth of the winter bud under 8-hour was very slow and number of leaves were far less than other daylengths. (Fig. 2) This fact shows that short-day conditions inhibit both formation of flower bud and dwarf-shoot.

From these results, it might be suggested that the inhibition of flower formation of seedlings under long-day and short-day conditions are due to the different reason.

Though 12-hour photoperiod was not used in this experiment, a tentative conclusion that *P. densiflora* is an intermediate plant might be reasonable.

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Summary

Photoperiodic treatments (8, 16, 24-hour) apparently inhibited flower initiation in seedlings. Female strobili was produced in many seedlings under natural day-length. However long-day and short-day might have different ways of inhibition.

The author bring a hypothesis that *P. densiflora* is intermediate plant.

Literature

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アカマツ苗木における日長処理と着花

助教授 郷 正 士

1年生のアカマツ苗を使って1年間日長処理をおこなって、日長と着花の関係をしらべた。その結果つぎのことがわかった。

1. 8時間, 16時間, 連続の日長処理はアカマツの着花を非常にはっきりとさまたげた。(表1)
2. 16時間と連続光の長日処理区の冬芽の最初ののびる時期は成木のハナメのできる時期と一致するため, ハナメが尋常葉にかわったためハナがつかなかったであろうと予想した。(図1)
3. 8時間の短日処理すると冬芽の成長が非常にわるく, 図2にみられるように尋常葉もすくないので, ハナメのもともハのもとも十分に成長しなかったと予想した。
4. アカマツ苗は16時間と8時間の日長では着花しないが, 自然日長で着花した。自然日長は8時間より長く日の出まえの30分を加えても日長が16時間より短いので, 定日植物であろうと推論した。