Decrement of Photoperiodic Stimulus in Transmission in *Pharbitis Nil*

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**Introduction**

In many short day plants a certain—for a given species a definite—number of photoperiodic cycles consisting of relatively short light periods and relatively long dark periods should be given in consecutive order to cause flower initiation (3, 8). Even if the photoperiodic cycle is an adequate one, short days less than the number required have no morphogenetic influence upon the growing point. The effects of two short days, which are given separately by inserting one long day between them, do not add up. The stimulus received on the preceding short day is annulled or dissipated on the succeeding long day. The disappearance of the stimulus may occur in every organ, stem, petiole and leaf blade. It is also conceivable that it may be a naturally occurring phenomenon and that the stimulus may be dissipated to some extent and decrease in intensity in transmission. In the experiments reported here it was endeavored to learn if the stimulus decreases on its passage through the stem.

**Material and Methods**

The principle of the method employed was based upon the following considerations. Should no decrease of stimulus occur on its way through the stem, a donor leaf subjected to a certain dark treatment would cause a similar flowering response in a receptor bud irrespective of its distance from the donor leaf. On the contrary, if this is not true, a difference in response would be detectable according to the distance between the donor leaf and the receptor bud. Flower initiation in the receptor bud on one branch of a two-branched plant induced by a donor leaf on the other branch, was compared with the response of a comparable bud induced by its subtending leaf.

To secure reliable results, the sensitivity of the donor leaf and the reactability of the receptor bud of both experimental and control plants must be strictly com-

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parable. Therefore in this experiment two-branched plants were used, since on the
two cotyledonary branches of equal vigor the corresponding leaves and buds may
be supposed to have the same physiological disposition.

The material used was the *Pharbitis Nil* strain “Violet”. Two-branched plants
were obtained in the same way as in previous experiments (6). Both branches
were topped above the second leaf. The second leaf on one branch served as donor
and the second bud on the other as receptor; all other leaves and buds were
removed.

Three lots of such plants were used in the experiment (Group I). One lot
received one short day consisting of a 16 hour dark and an 8 hour light period.
The other two lots received 2 and 3 short days respectively. Nine other lots of
similar plants were used as control. On the two branches the second bud and its
subtending leaf were left intact, therefore each plant had 2 receptor buds. Three
lots (Group II) were given one, two and three short days starting on the same day
as the experiment with group I. Three further lots were subjected to short day
treatment in the same manner starting on the next day (Group III). A further
day later the short day treatment of the last group (IV) was started.

In the experimental group the stimulus may have been delayed one or more
days in arriving to the receptor bud (6), and the bud may have varied in sensitivity
during this time. In order to investigate the change in sensitivity, 3 control groups
were employed in which short day treatment was started after the lapse of a
varying number of days from the beginning of the experiment. From the com-
parison of responses in these 3 control groups one could find the change in react-
ability of the receptor bud after topping, under the assumption that the photoperiodic
sensitivity of the donor leaf did not change.

The time in which the stimulus reaches the receptor bud in an experimental
plant, can be estimated by comparing the position indicating number of the first
flower primordium on its receptor shoot with that of the control plants, as reported
in a previous paper (6). The “position indicating number” of the first flower
increases with the increasing delay of the arrival of the stimulus at the receptor
bud.

**Results**

Experiment 1. Dark treatment was started on June 21, and observations were
made on July 14, 1954. The results are summarized in Table 1. In all plants the
average number of flower primordia initiated increased with increasing number of
short days given. In all control groups the same dark treatment had almost the
same effect as revealed by the number of flower primordia initiated, indicating that
no remarkable change in reactability of receptor buds took place during the experi-
mental treatment.

The response of the experimental group is in distinct contrast to that of the
control groups. Plants, whose donor leaf and receptor bud were separated from each other by a stretch of the stem of ca. 4.6 cm, did not respond to a single short day but initiated flower primordia when 2 or 3 short days were given, though in far lesser number than the control plants, in which the subtending leaf of the receptor bud was the donor. After having received 3 short days all control plants, but only about one third of the experimental plants, produced flower buds. From these results it can be concluded that the stimulus becomes markedly weaker on its way while passing through the stem.

In control groups the position indicating number of the first flower increases with increasing delay of the start of short day treatment, indicating that more basal buds are determined as vegetative according to the length of the interval following the removal of the main axis. It is also noteworthy that within each control groups the position indicating number of the first flower is independent of the number of short days given. In the experimental group, however, the number increases with the number of short days given. Two short days induced the first flower on the 1.8th and three short days on the 2.8th node on the average. This may be due to the fact that owing to the decrease of the stimulus only a weak impulse reached the receptor buds in the plants which received two short days and flowering was induced only in the most sensitive individuals, but when the plants received another short day, more stimulus was transmitted causing flower initiation.
in less sensitive plants, and an increase of the position indicating number was the result.

Experiment 2. The results of another similar experiment, started on May 19, 1955, is shown in Table 2. The plants used in this experiment were very sensitive and many terminal flowers were produced. The reactability of the receptor buds showed no change during the treatment. The position indicating number in the experimental group corresponds approximately to that of the third group, indicating that the stimulus in the experimental plants reached to the receptor bud about one day later than in the second group. Comparing the flowering response of the experimental group with that of the control group, a distinct difference can be seen. In the number of flowering receptors, in the number of receptors with terminal flower and in the average number of flower per receptor, the control groups markedly exceed the experimental group, in which the stimulus had to travel a stretch of the stem of ca. 7.6 cm. The results obtained are quite similar to those of Experiment 1.

Discussion

The flowering response of many short day plants, when a branch or a leaf is subjected to short day, is remarkably weakened by the presence of branches or leaves exposed to non-inductive light condition. In soy bean short day treatment given to one branch can cause flower initiation on another branch of the same...
plant exposed to non-inductive light period, only when the latter is deprived of its leaves (1). The short day stimulus received by a donor branch of *Xanthium* can be more readily transmitted to a leafless receptor branch than to a receptor with leaves on long day (4). Such behavior was observed in many plants. It may be ascribed to various circumstances. In the first place the non-inductive leaves per se may counteract flower initiation. In *Perilla nankinensis* flowering occurs when the basal half of the leaf alone is exposed to short photoperiod. When the apical half of the leaf is exposed to short photoperiod the plant does not flower if the basal half is exposed to long day, but does if it is continuously maintained in darkness (2). In the second place the phenomenon may be ascribed to the generation of a solute stream from the non-inductive leaves opposed to the solute coming from the induced leaves. This explanation is very strongly supported by observations in *Kalanchoe Blossfeldiana* (5). The inhibitory effect is exerted exclusively by leaves located between the source of stimulus and the receiving bud, and the leaves on the same orthostichy with the donor leaf have a more pronounced effect than other leaves.

In *Kalanchoe* not only the non-inductive leaves but also the leaves kept in continuous darkness exert an inhibitory effect (10). Such leaves appear to act as sidetracks which intercept the solute stream carrying the floral stimulus, as Lang pointed out (7). This explanation seems very plausible, since in the present research the stimulus was found to become to some extent dissipated in normal transmission along the stem.

**Summary**

1) In two-branched plants flower initiation of the receptor bud on one branch induced by dark treatment given to the donor leaf on the other branch was compared with that of the axillary bud of the donor leaf.

2) The response was markedly reduced, when the donor and the receptor were separated by a stretch of stem, indicating that the stimulus was dissipated in the stem during transmission.

**Literature**