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Division of Pomology, Oleiculture and Viticulture

# THE PHYSIOLOGY OF REST AND ITS APPLICATION TO FRUIT GROWING

## (Third Report)

by

R. M. Samish, S. Lavee and A. Erez

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## SUMMARY

During the period of this third report, results obtained previously were checked and further developed.

With respect to the form of chilling, a varietal difference in response to cyclic vs. continuous chilling seems to exist. The Elberta peach uses chilling hours supplied by cyclic chilling more efficiently than those supplied by continuous chilling. The Redhaven peach evinces no such difference.

Light was shown to be essential, in addition to chilling, for the opening of leaf buds. Terminal buds, however, were only slightly inhibited by the absence of light.

Leaf bud opening is favored by a long-day photoperiod which may be replaced by an additional midnight illumination at a short photoperiod.

The active part of the spectrum lies in the red field and can be antagonized by far-red if applied immediately after the red irradiation.

This relative activity of different parts of the spectrum, together with the observation on the efficiency of the midnight break, support the theory that phytochrome is involved in the action mechanism of the phenomenon.

The change in light conditions outdoors in winter revealed that darkness in spring practically prevented leaf bud awakening, while supplementary light markedly increased the percentage of bud opening.

In experiments under field conditions, the effect of sunlight filtered by colored filters on bud opening in the peach confirmed the results obtained earlier under artificial light conditions.

A preliminary investigation of the light effect in other dormant deciduous woody plants indicated a similar reaction in apples and grape vines.

I. Chilling requirements in relation to different cooling procedures

Since different results obtained, when the chilling requirement of peach buds was satisfied by continuous cooling as compared with intermittent cooling, it was thought desirable to repeat these experiments.

Three years ago (3) we reported that alternating temperatures (6-16°C) were more efficient than constant temperatures in breaking the dormancy of buds of excised Elberta peach shoots. In our last report (4) we showed that excised Redhaven shoots were less sensitive to this effect, and bud opening on intact plants of this variety was not enhanced by the alternating chilling.

One-year-old plants of both varieties, growing in 4-gallon containers, were subjected either to a constant 6°C or an alternating 6-18°C temperature. The plants were kept in the dark during chilling . Groups of plants were transferred to warm chambers with a daily illumination of 16 hours (fluorescent light) on three successive dates. After 21 days in the warm chamber, opening of leaf buds was recorded separately for the main center branch and the lateral shoots (Table 1).

On the basis of the number of days of treatment, the constant low temperature was the more efficient in breaking dormancy of Redhaven, but not so with Elberta, where similar results were obtained under both conditions. No consistent difference in leaf bud break was found between that of the main branch and of the lateral shoots. When the amount of chilling was calculated according to the conventional chilling threshold of 7.2°C, a somewhat larger number of buds would seem to have opened in the vicinity of 800-1000 chilling hours under the alternating regime than at constant temperature (see Fig.1A).

TABLE 1

THE EFFECT OF CONSTANT (6°C) AND ALTERNATING (6-18°C) COOLING ON LEAF BUD BREAK OF ONE-YEAR-OLD REDHAVEN AND ELBERTA PLANTS
(Results expressed as percent bud break after 21 days in the lighted warm chamber)

| Variety | Days of cooling | 6°C | | Days of cooling | 6-18°C | |
|---|---|---|---|---|---|---|
| | | main branch | lateral shoot | | main branch | lateral shoot |
| Redhaven | 44 | 62 | 49 | 38 | 7 | 4 |
| " | 50 | 58 | 58 | 48 | 11 | 10 |
| " | 68 | 81 | 88 | 66 | 61 | 42 |
| Elberta | 68 | 84 | 91 | 66 | 87 | 84 |

A continuous linear increase in bud break was obtained between the two systems, finding the threshold temperature at 9.5°C (fig. 1B). Thus it might be suggested that temperatures above 7.2°C are effective, as was proposed earlier.

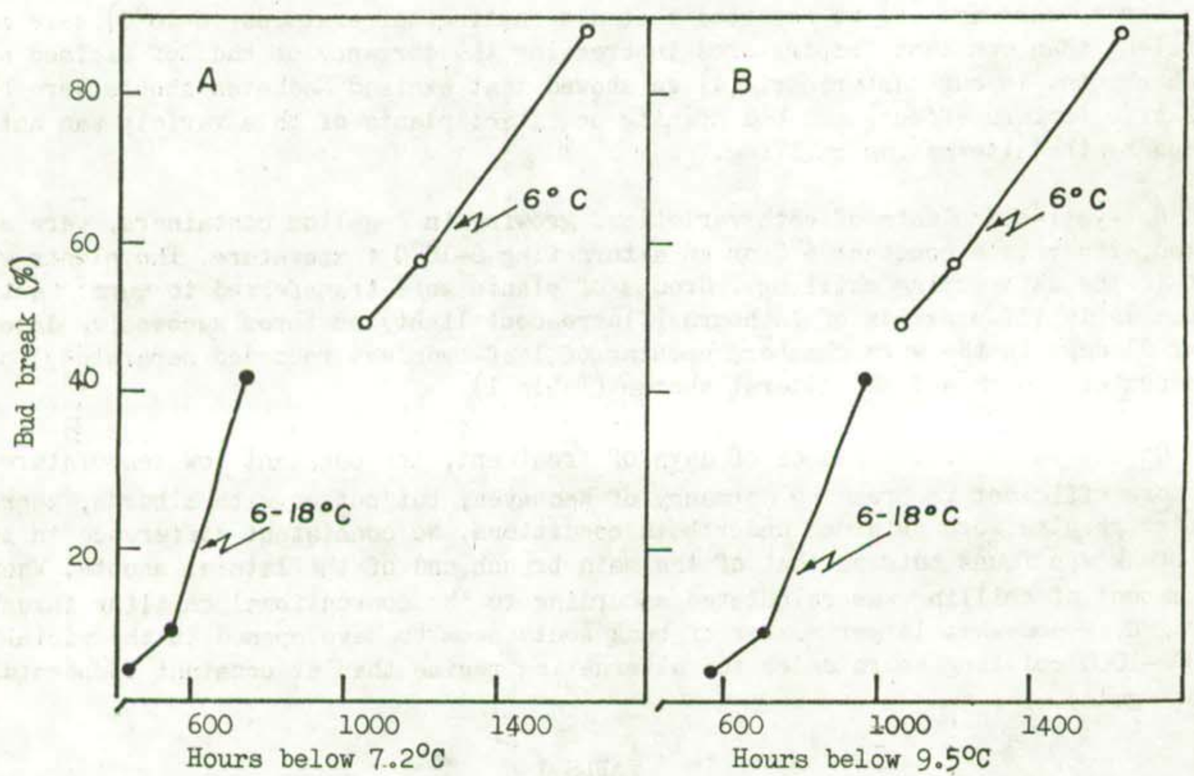


Fig. 1 The effect of different amounts of continuous and intermittent chilling on leaf bud burst of the Redhaven peach. (One-year-old plants held during chilling in the dark at continuous 6°C or intermittent 6-18°C; and during 23 days of forcing conditions continuously at 23°C under a 16-hr daily cycle. Chilling hours were calculated below the threshold values of (A) 7.2°C and (B) 9.5°C.)

These results indicate that there is no, or only a very slight enhancement of leaf bud break due to alternating as compared with continuous chilling in the case of the Redhaven plant. It can also be concluded that the warm temperatures of the alternating daily cycle did not reverse or reduce the chilling effect of the low temperatures in the cycle.

With Elberta after 68 and 66 chilling days, respectively, 91% of the leaf buds opened in the 6°C chilling, and 84% in the 6-18°C chilling system. Therefore, when hours of chilling were calculated on the basis of a threshold of 7.2°C, 740 hours of alternating temperatures had an effect on bud opening similar to that of 1630 hours of continuous low temperature.

The results for both the Redhaven and Elberta correspond well with those obtained in the previous seasons. It might therefore be concluded that the generally higher efficiency of alternating cooling on excised shoots (3) is not attributable merely to an artifact, but rather to differential responses by different varieties.

II. Bud opening in relation to light and different cooling procedures

Last year the first indications were obtained that light plays a major role in the process of terminating leaf bud dormancy. It was shown that leaf bud opening was light-dependent, while flower bud opening was not. The light requirement in leaf bud opening was suggested to be independent of the state of fulfillment of the chilling requirement. The active light spectrum was found in the red range. During the present year the light effect on bud burst was further investigated and established.

In order to test the methodology, a comparison was made between the leaf bud break on one-year-old intact and excised shoots of the same plants. They were chilled in a constant and alternating system and forced, after cooling, in three different light regimes. Redhaven plants and excised shoots were taken at the end of December and chilled for 67 days in the dark at 6°C or 6-18°C, and then forced in a warm chamber (23°C) for 21 days in the dark, or given 16 or 24 hours daily illumination (Fig. 2).

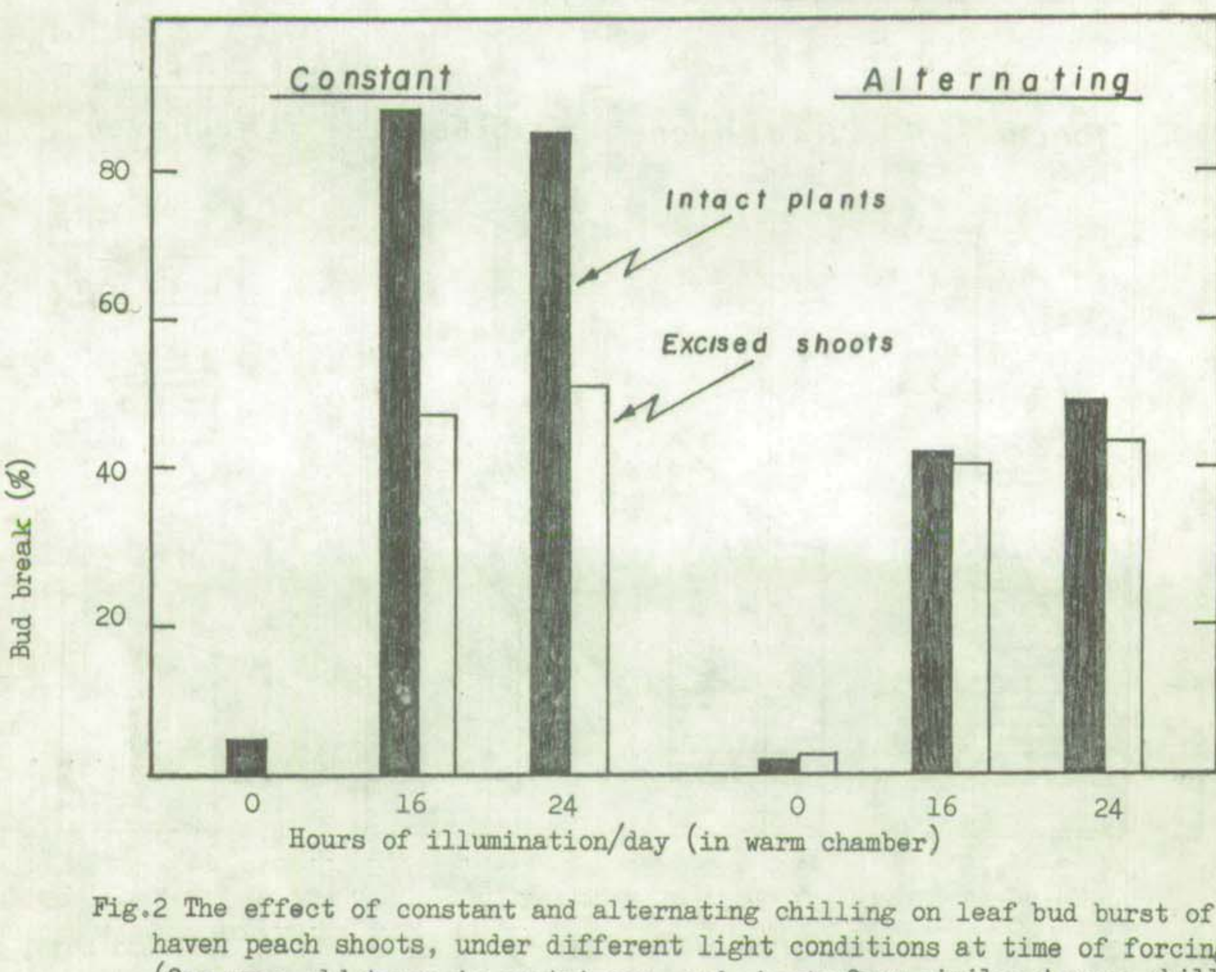


Fig.2 The effect of constant and alternating chilling on leaf bud burst of Redhaven peach shoots, under different light conditions at time of forcing. (One-year-old trees in containers, and shoots from similar trees; chilling in darkness for 75 days at constant 6°C or alternating 6-18°C for potted plants, and 6-16°C for excised shoots;forcing for 21 days at 23°C with light for 0,16 or 24 hours daily.)

In the dark, leaf bud burst was generally inhibited, irrespective of chilling method and the type of the plant material, i.e., intact or excised shoots.

No significant difference in bud break was found in this experiment between 16 and 24 hours' illumination, irrespective of the cooling method or the type of plant material. The same number of days of constant chilling (at 6°C), however, was more efficient in effecting opening of buds of intact plants than the alternating temperatures, while this difference was not found with excised shoots. In this experiment no interrelation between the effects of chilling and light could be demonstrated. The light effect was independent of the chilling system and the form of the plant material.

The relation between the effects of amount of chilling and light was tested on excised shoots. One-year-old Elberta and Redhaven shoots were collected on Dec. 18, 1963 from one-year-old and mature trees, and chilled in the dark at 6°C for 44 and 68 days. Bud opening was determined after 21 days in warm chambers (23°C) both in the dark and in light (Fig. 3).

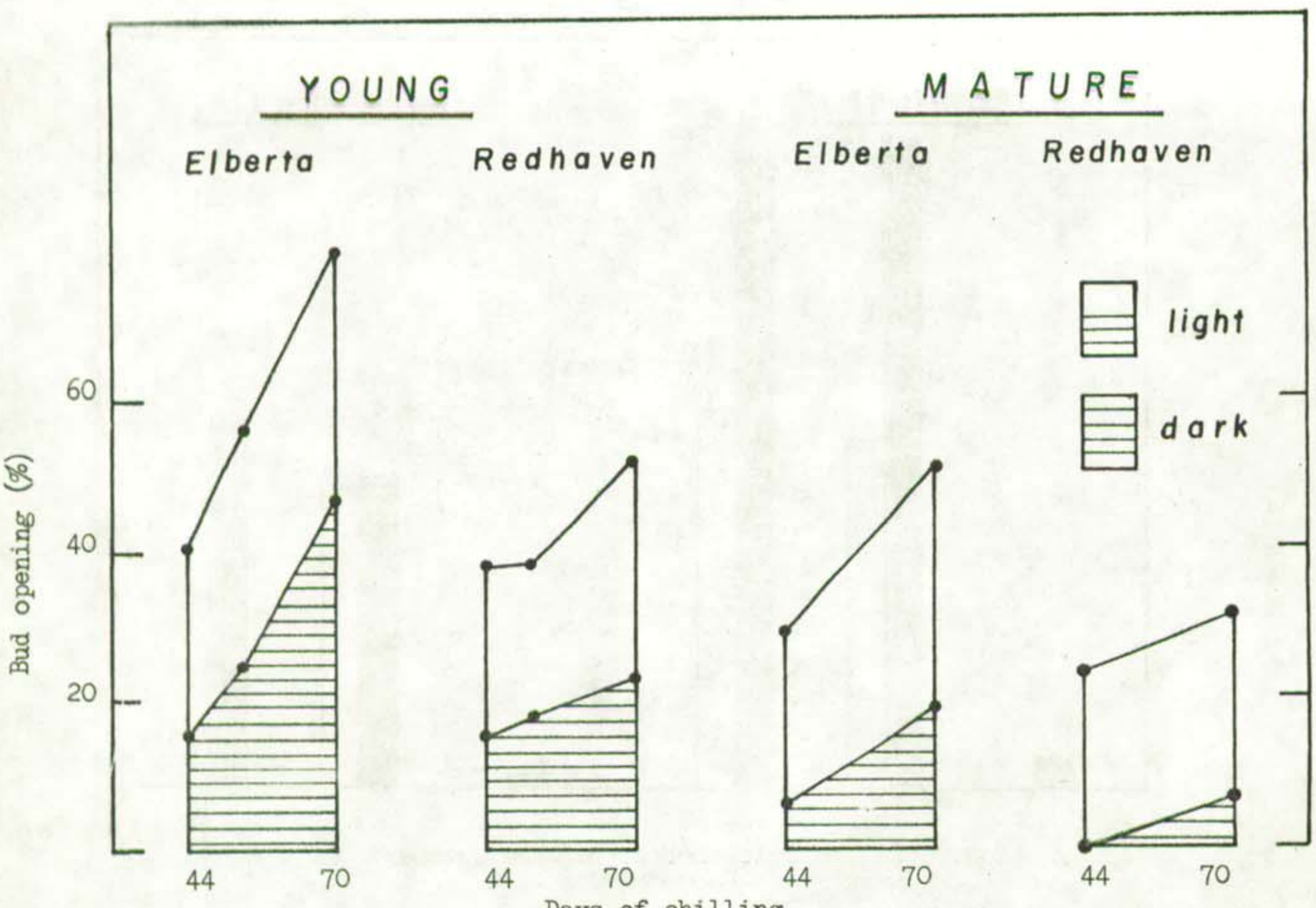


Fig. 3. The interrelation of light and chilling in their effect on leaf bud burst of shoots from young and mature Elberta and Redhaven trees. (Shoots cut in the orchard on Dec. 18, 1963; chilling at 6°C in the dark for 44, 53 or 70 days; forced at 23°C under continuous light or darkness for 20 days.)

In this experiment the leaf buds on shoots of young trees in both varieties opened more readily than those on shoots from mature ones, in light as well as darkness. This may indicate a lower requirement for chilling and light with younger trees. It was also apparent that more Elberta buds opened more readily than those of Redhaven from trees of similar age. In the dark, leaf bud break was relatively low in both varieties and ages, even after the longer chilling. The addition of light promoted leaf bud break in both chilling periods. The long chilling followed by forcing in light generally caused the highest leaf bud opening. From Fig.3 it is very apparent that the light effect is additive to that of chilling and appears to be constant within the observed chilling range in determining the extent of bud break. It would seem that one is independent of the other, therefore the light effect appears to be relatively large when chilling is insufficient.

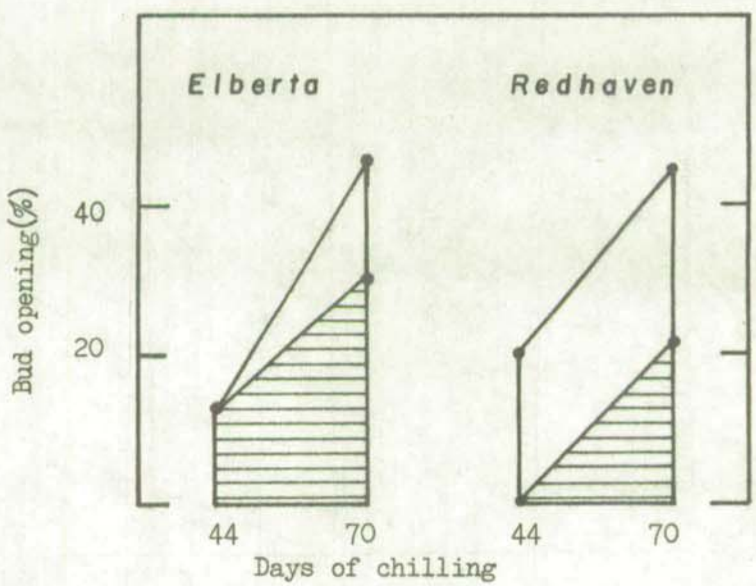


Fig. 4 The effect of light and chilling on flower bud break of Elberta and Redhaven peaches. (For details, see Fig.3)

The flower buds on the shoots from the mature trees reacted to light in a manner similar to leaf buds (Fig. 4) except in the case of Elberta, which had received the low chilling treatment. This response differs from our previous findings, that light reduces flower bud opening, but it should be noted that in this experiment the light intensity was much weaker than in our earlier work, i.e., 16 f.c. vs. 320 f.c., as the shoots were kept at a distance of 2m from the light source as compared with 10-20cm in previous experiments with excised shoots. This corresponds to our earlier observation (4) that although flower bud burst is generally inhibited by light, small amounts of light can enhance it. This relatively low light intensity did not interfere with its effect on leaf bud opening.

In a preliminary experiment, the interrelation between a thermal cycle during chilling and a light cycle during forcing, was tested. Excised Elberta and Redhaven shoots chilled at 6° and 6-18°C for two time periods (44 and 68 days) were forced in the warm chambers in constant and cyclic (16 hours daily) illuminations and in darkness. The results, as percent of bud opening in each combination (of chilling and light), are presented in Fig. 5.

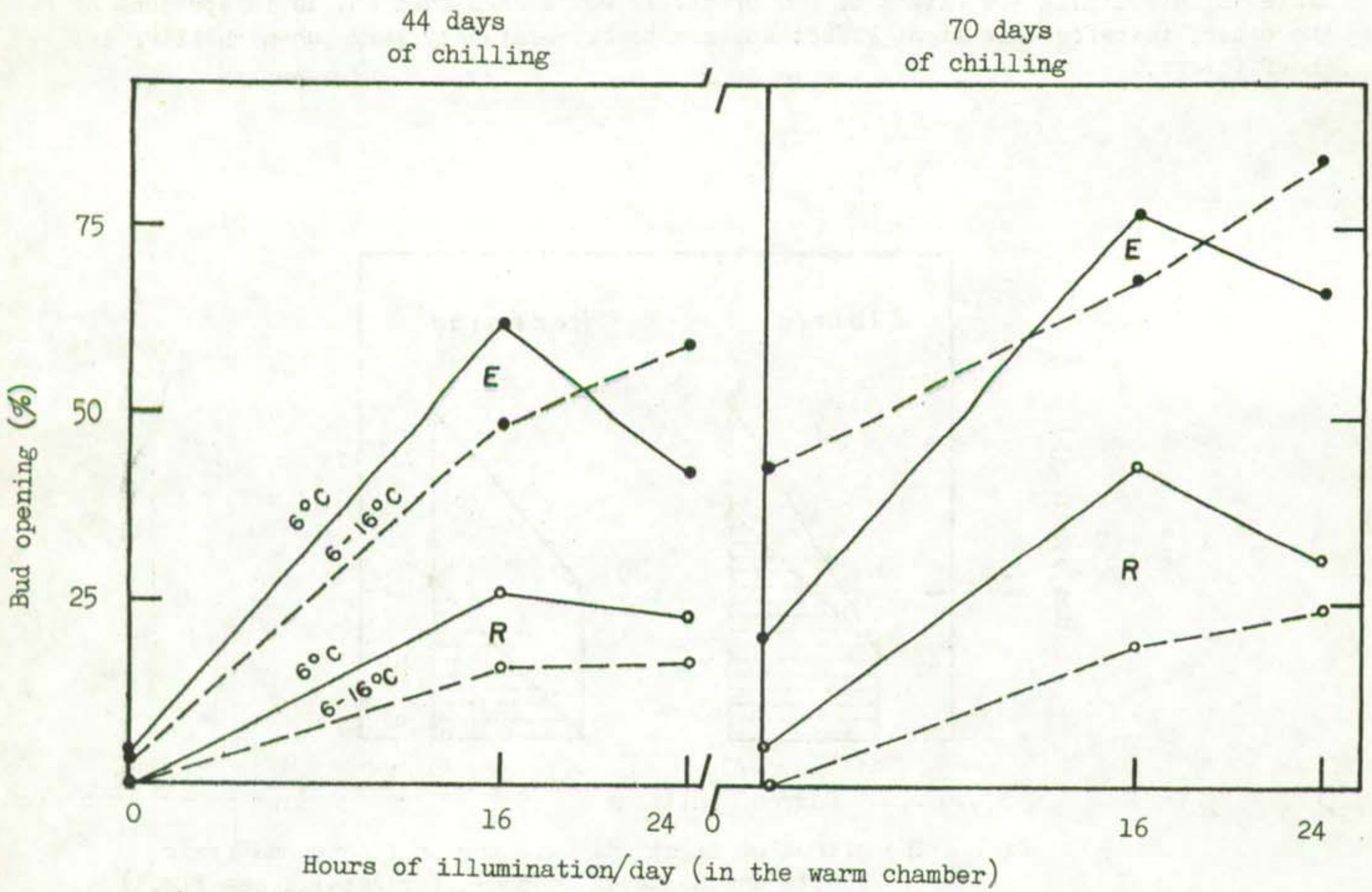


Fig. 5 The interrelation between daily cyclic cooling and cyclic illumination in their effect on leaf bud burst of Elberta (E) and Redhaven (R) peaches. (Excised shoots collected Dec. 18, 1963, and held at 6°C or 6-16°C in darkness for 44 or 70 days; forcing for 20 days at 23°C under 0, 16 or 24 hours of light daily.)

The percent of bud break in this experiment was rather high in all lighted treatments. Still, a rather definite correlation was found between percent bud break and the different combinations of chilling and light. It would seem that when one of the two factors (cold, light) was given in an alternating, cyclic manner and the other as a constant treatment - the percent bud break was considerably higher than in treatments where both light and chilling were given according to the same principle, either as constant or as an alternating cycle. This was the case when either a high or a medium number of chilling days was given. Such behavior would correspond to thermoperiodism (6). No suggestion for a possible explanation of the metabolic pathways involved can be offered before further investigation of this phenomenon is made.

III. Bud opening in relation to light at time of forcing.

While the qualitative effect of light was established, the quantitative aspect required further investigation. The effect of light duration was further investigated on leaf and flower buds by reducing the daily illumination from a previous minimum of 8 hours (see Ref. 4) to as short a period as 75 minutes. In this experiment red light, which had been found by us previously to be the active part of the spectrum, was used. Excised Elberta shoots were collected on Nov. 5, 1963, and chilled in the dark at 6°C for 77 days. After this they were subjected to different light cycles in warm chambers for 20 days (Fig 6).

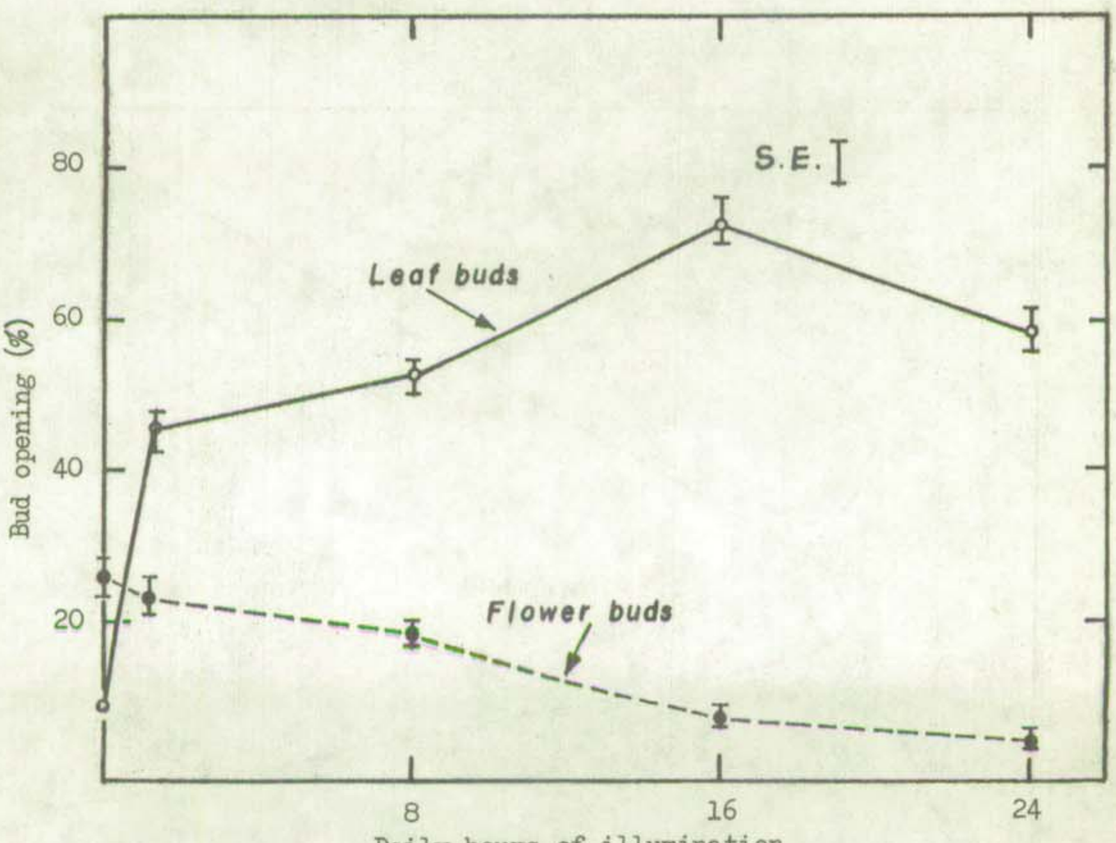


Fig. 6 The effect of various daily cyclic light periods on leaf and flower bud burst of the Elberta peach. (Excised shoots collected Nov. 5, 1963, held at 6°C in darkness for 77 days. Forcing for 20 days at 23°C under 0, 1¼ , 8 16, or 24 hours of light daily.)

A diurnal cycle of about one hour light was enough to cause a major increase in leaf bud break. Further increase in the duration of the daily illumination resulted in increased leaf bud break up to an optimum under long-day conditions (16 hours light daily). Continuous light was less effective in promoting leaf bud break, which corresponds to our above mentioned findings concerning the relative effect of cyclic and constant conditions.

Flower bud opening was negatively correlated to the length of daily light cycle, with the continuous dark treatment causing the strongest flower bud opening. These results suggest that in spite of the strong effect of small amounts of light on leaf bud break, a longer exposure is needed for maximal opening. In addition, the data support a photoperiodic nature of the light effect.

The effect of various periods of constant illumination was studied and compared with the efficiency of very short (75 mins.) and short (8 hrs) daily light cycles. Elberta shoots collected on Dec. 12, 1963, and chilled (6°C) in the dark for 67 days were transferred to warm chambers with: (a) continuous red illumination for 32, 80 and 384 hours (the first two followed by darkness up to a total period of 384 hours); (b) a 75-min. as well as an 8-hour daily red light cycle; and (c) complete darkness. Leaf and flower bud break was recorded after 16 days in the warm chamber (Fig. 7).

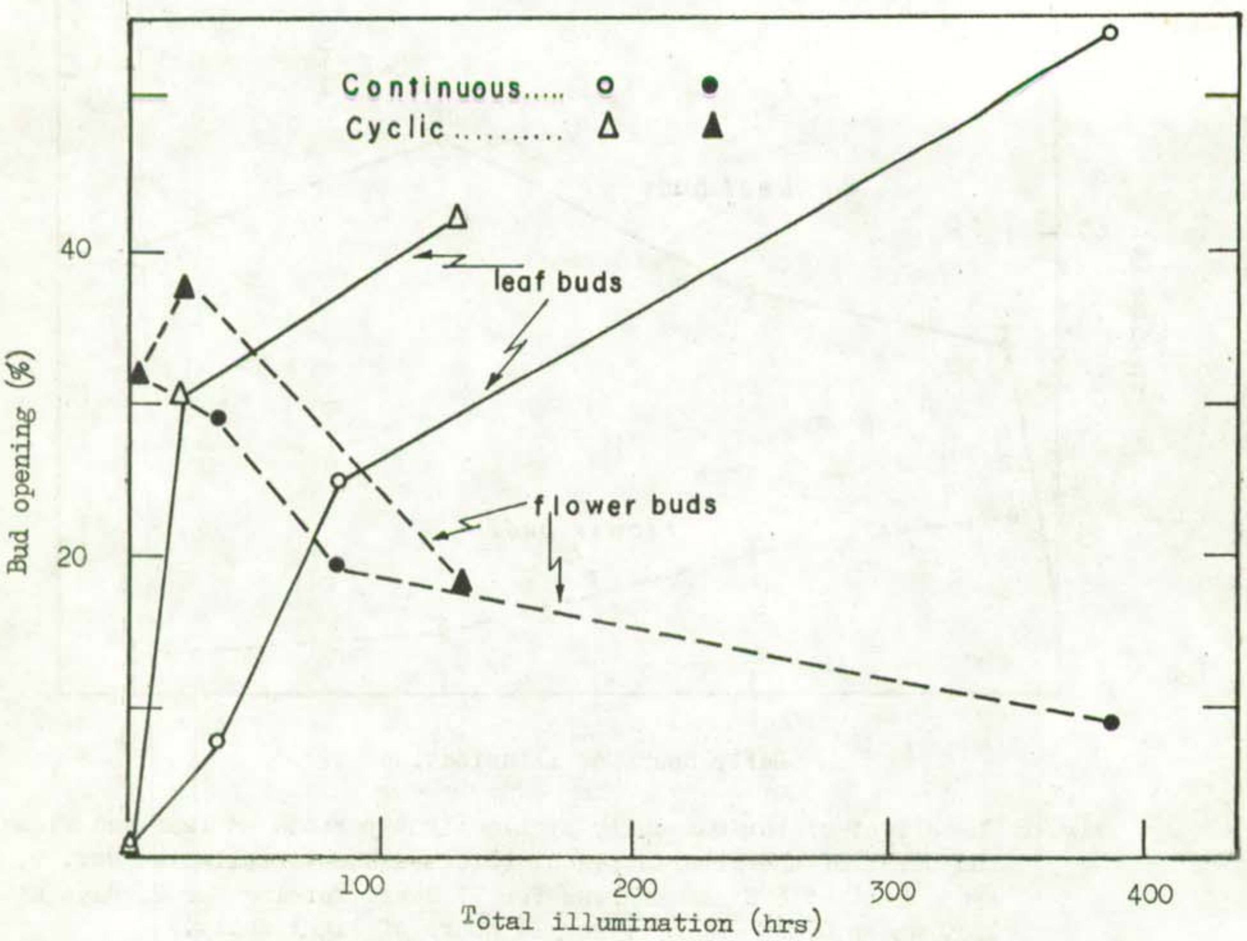


Fig. 7 The effect of varying lengths of continuous and cyclic illumination on leaf and flower bud break of the Elberta peach(Excised shoots collected Dec.12,1963; chilled at 6°C in darkness for 67 days;forced for 16 days at 23°C under 0, 32 or 80 hours of continuous light, or 1¼ or 8 hour daily cycles.)

The increase in light duration caused an appreciable definite increase in leaf bud opening and a decrease in flower bud opening. Shorter periods of illumination showed a greater effect per unit hour than the long one. Furthermore, it will be noted that the short cyclic illumination, with a total of only 20 hours of light, was markedly more efficient in causing leaf bud burst than even four times as much constant light. As against this, the short cyclic illumination had only a slight, not significant enhancing effect on flower bud opening. Longer cyclic illumination caused the increasingly inhibitory effect met in previous experiments.

As relatively short illumination periods were found to affect leaf bud break, such periods followed by darkness were tested on shoots chilled naturally in the field. The effect of colored light on bud break was retested under such conditions. Excised Redhaven shoots were collected from the orchard on March 2, 1964, shortly before natural bud break and transferred directly, without additional cooling, into the warm chambers. There the shoots were illuminated for four days with different filtered lights. After a subsequent dark period of 16 days, the percent of open buds was determined (Fig. 8).

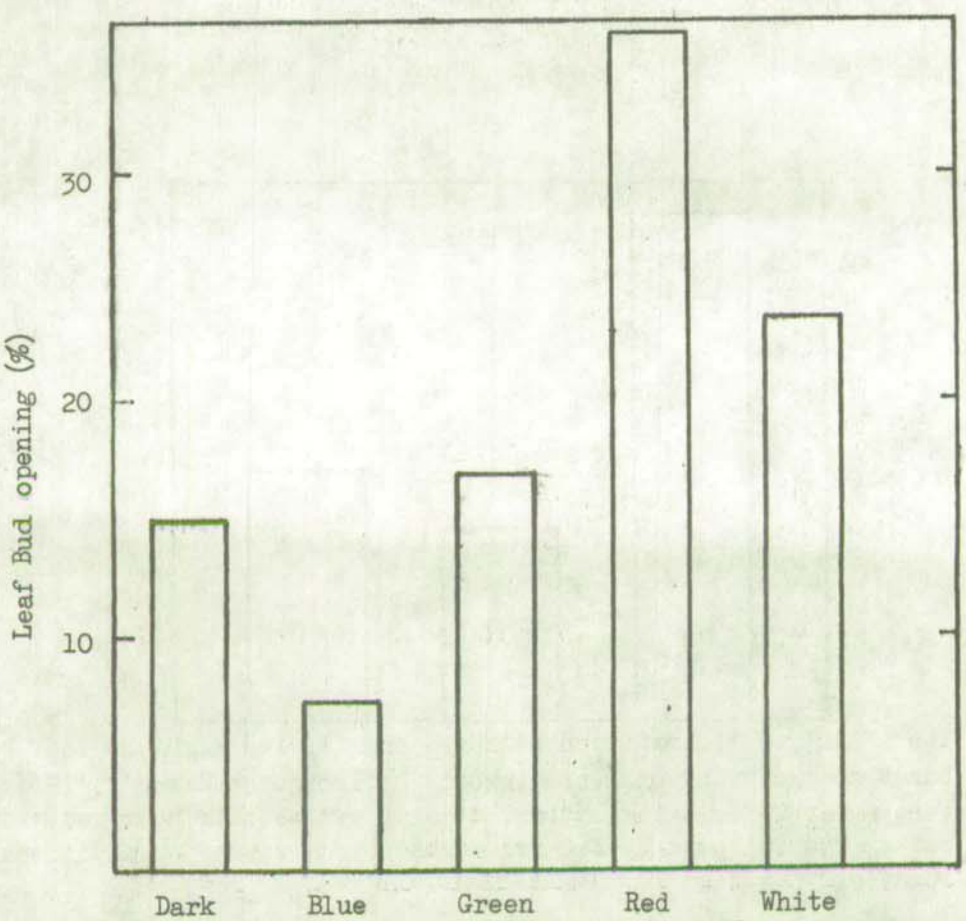


Fig. 8 The effect of a short illumination with different colored lights on leaf bud break of the Redhaven peach (Shoots collected on March 2, 1964; forcing at 23°C under continuous illumination with white, red, green or blue lights for 4 days, followed by darkness for an additional 16 days. A parallel group was kept in total darkness for the full 20 days.)

Generally, the Redhaven leaf buds reacted to the various light stimuli in a way similar to that found a year earlier for Elberta in spite of the markedly different experimental conditions. The relatively hight percentage of leaf bud break in the dark treatment this year might be due to a previous light stimulus received in the orchard. The shoots were taken from the orchard very close to bud break and had not received any additional dark preconditioning, as compared with all other experiments. The red light promoted leaf bud break under this year's conditions even more than the white, and the blue caused the same slight inhibition as found previously for Elberta. The shorter light period (4 days) was enough to cause the "light effect" on leaf buds, whereas the subsequent dark period did not reveal noticeable reversing or inhibiting phenomena. Flower buds which had already begun to swell in the orchard seemed to have passed the light-sensitive stage at the time of sampling, as in all treatments flower buds opened readily. Furthermore, after the red and white light treatments, the percent of flower bud break was even 15-20% higher than after the blue or green ones, or when not exposed to light.

Since a relatively short illumination by red light caused a high percentage of leaf bud break, these buds were tested for activity of the phytochrome pigment system (1). The spring-collected Redhaven shoots were given, in a warm chamber, four cycles of 1 hour red (R), far-red (FR) and red, followed by far-red illumination. Percent leaf bud opening after 16 additional days in the dark is shown in Fig. 9.

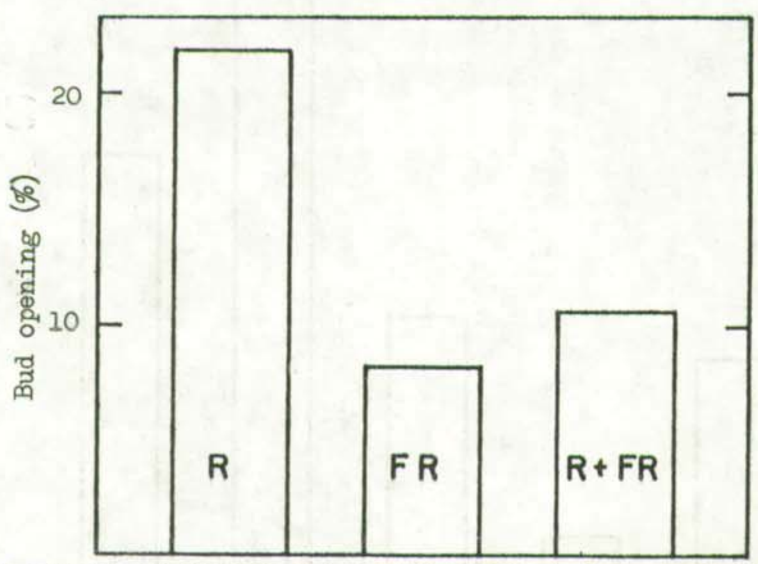


Fig. 9 The effect of illumination with red and far-red light on leaf bud burst of the Redhaven peach.(shoots collected on March 2, 1964; forcing at 23°C. Illumination: 4 daily cycles of 1 hour red, far-red or red followed by far-red ensued by darkness for additional 16 days.)

The percentage of bud break in this experiment was rather low, possibly because of the small total amounts of light. However, the inhibitory effect of far-red light was clear. The far-red illumination following the red reversed the bud breaking effect of the red light. These results indicate that the phytochrome pigment system is involved in the opening of peach leaf buds.

The observations of the high activity of cyclic illumination on leaf bud break, together with the maximal effect under long photoperiodic conditions (16 hours daily), led to an examination of the photoperiodic night-break effect on these buds. The Redhaven shoots which had been collected in spring (March 2) were tested (without additional cooling) for leaf bud break under short - and long-day conditions. Their effect was compared with a short-day treatment when the long night was interrupted in its middle by 1 hours' illumination. As before, only four light cycles were given in the warm chambers, followed by 16 days of darkness. Results with both white and red light are shown in Fig. 10.

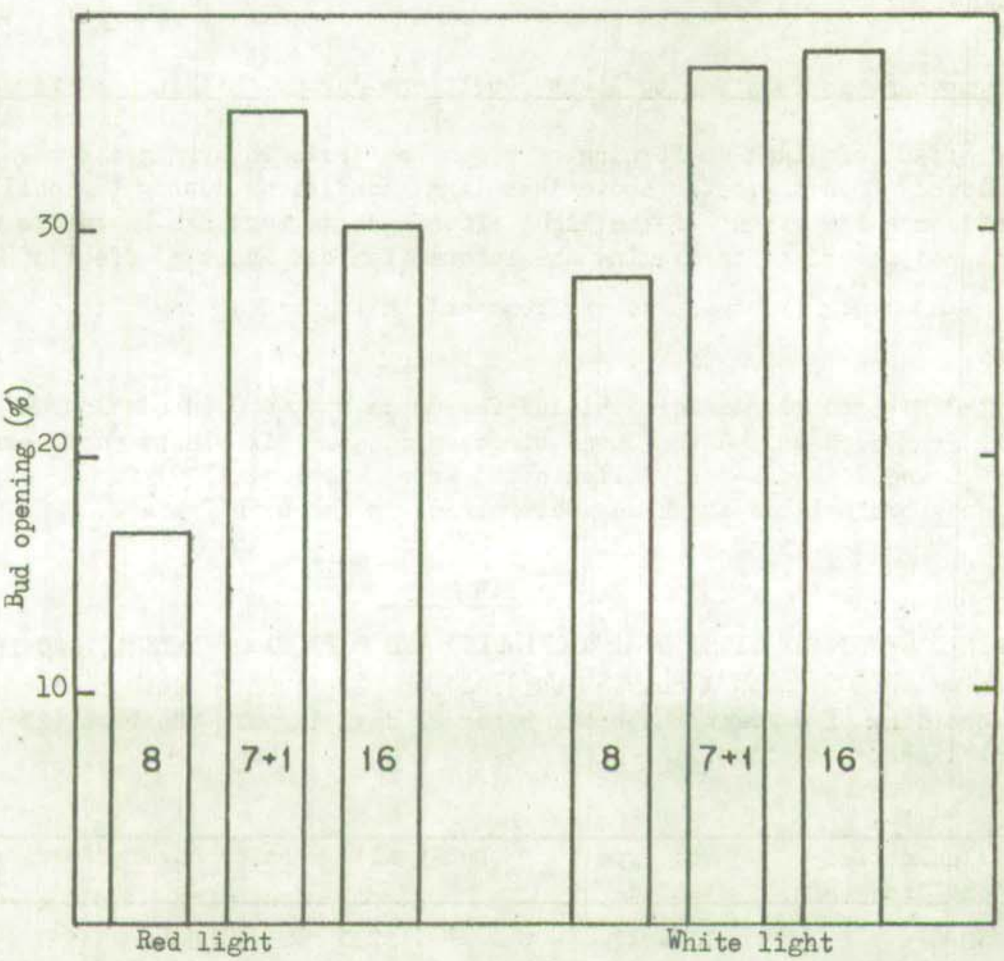


Fig. 10 The effect of a short photoperiod with a midnight light break, as compared with short and long photoperiods, on leaf bud burst of the Redhaven peach. (Shoots collected on March 2, 1964; forcing at 23°C for 4 days under 8, 16 or 7 + 1 (midnight) hours of white and red light daily)

Both the white and red light revealed a photoperiodic reaction. When the main short photoperiodic (8 hrs) was shortened by 1 hour, which was applied as a midnight break, long-day conditions were simulated. The four light cycles were sufficient to show the advantage of long-day conditions for the leaf bud break.

The photoperiodic nature of the reaction and the probable presence of phytocrome suggest that leaf bud opening is governed by a combination of two types of reactions: a light reaction producing the photochemical impulse for the bud opening and a dark reaction regenerating a precursor for the light reaction. It is suggested that in this case, similar to that with seeds (1,2) the phytochrome pigment must be kept for a long period in the active far-red form in order to cause leaf bud break. This is achieved by preventing a long dark period during the active stage. The effectiveness of small amounts of light indicates that a photomorphogenetic process with a rather low light saturation level governs leaf bud break in the peach. Such a system might explain the high efficiency of diurnal cyclic illumination versus that of continuous light, the better effect of long photoperiods as compared with short ones, as well as the strong effect of relatively short illumination (4 days) which is not anulled by subsequent darkness.

## IV. Bud opening in relation to light conditions during chilling and forcing

The effect of light on forcing of peach leaf buds in spring has been established. It has already been indicated above that light conditions during the chilling period might influence the extent of the light effect during forcing. Therefore experiments were designed in order to examine the interaction between the effect of light given as a preconditioning treatment during rest and that given at the time of forcing in spring.

Potted Elberta plants were chilled for 68 days at 6°C in continuous darkness or in light. From each of the two conditions, groups of six plants each were transferred to dark, 16 and 24-hours-daily illuminated warm chambers (23°C) for 22 days. Percent lateral and terminal bud break was determined, as shown in Table 2.

TABLE 2

THE COMBINED EFFECT OF LIGHT DURING CHILLING AND FORCING ON LATERAL AND TERMINAL LEAF BUD BREAK OF INTACT ELBERTA PLANTS (Chilled Dec. 24, 1963 - March 8. 1964 in dark and light; recording of percent bud break after 22 days in warm chambers (23°C) under 3 different light conditions.)

| Daily illumination during chilling (hrs) | Bud type tested | Daily illumination during forcing (hrs) 0 | 16 | 24 |
|---|---|---|---|---|
| 0 | lateral | 20.0 | 89.4 | 91.3 |
| | terminal | 74.0 | 90.8 | 99.3 |
| 24 | lateral | 39.2 | 94.3 | 88.3 |
| | terminal | 98.0 | 98.8 | 98.1 |

As shown earlier with excised shoots, darkness at time of forcing in the warm chamber also markedly reduced the amount of lateral leaf bud burst with intact plants. This was also the case, though to a lesser degree, with terminal buds, when they had been dark preconditioned during the cooling period, but not after previous light treatment. Thus dark preconditioning enhanced the light requirement at time of forcing. It might be postulated that light given during the chilling period contributed to the requirement for light at time of forcing. Terminal buds were markedly less inhibited by darkness at forcing time. This lower light requirement corresponds to their lower chilling requirement. The quantitative difference between lateral and terminal buds in bursting might be associated with the different level of growth-regulating substances in the buds (5) , i.e., auxins, gibberellins and flavonoid compounds (naringenin). These or related substances, which were found to be part of the dormancy breaking and bud opening metabolism, may play together or in part a primary role in the dark and light reactions as governed by the phytochrome pigment system.

Since under controlled conditions the light effect on leaf bud break was similar in both excised shoots and intact plants, the influence of light during winter in relation to light conditions in spring was examined on naturally wintered plants under outdoor conditions at Bet Dagan.

On Jan. 29, 1964, three groups (18 plants each) of one-year-old Elberta plants, kept outdoors in 4-gallon containers, were each (a) placed in a dark tent, (b) supplemented with artificial illumination during the night, or (c) left in natural light conditions. On March 2, shortly before expected bud break, the plants from each group were divided into three equal parts: one was left in place and the other two were transferred to the alternative treatments. Thus, nine groups receiving different combinations of winter and spring light conditions were formed. About one month later, on April 7, 1964, the percent of lateral leaf bud break was determined in each group (Fig. 11).

Similar to the results obtained under controlled thermal conditions, light at sprouting time was found to be obligatory for bud opening also in this outdoor experiment. In this case, this was so regardless of the light conditions during the winter. The addition of light to the natural day-night cycle at sprouting time increased bud break in all of the different light preconditioning treatments. The preconditioning, however, had a marked effect on bud opening. Best results were obtained when the plants were dark-preconditioned in winter and received either natural or continuous (supplemented) light during spring. These light conditions approach those prevailing at higher latitudes during these seasons. Supplemented light during winter increased bud opening, though to a lesser extent than darkness. As with controlled conditions (see Table 2) here, too, it is possible that the "winter" effect of light stems from its contribution to the requirement of light at time of forcing, as the date of transfer from one light treatment to the other was somewhat arbitrary.

It should be noted, however, that natural conditions both during preconditioning and forcing caused the weakest bud break of all the treatments receiving light during forcing. This weak bud opening might be due to the repetition of the same light conditions in winter and spring which seem to be less favorable for leaf bud break. It should be noted that the chilling requirement of the plants in this experiment was not entirely fulfilled, hence the percent of leaf bud break in the control (natural/natural) was quite low (14%).

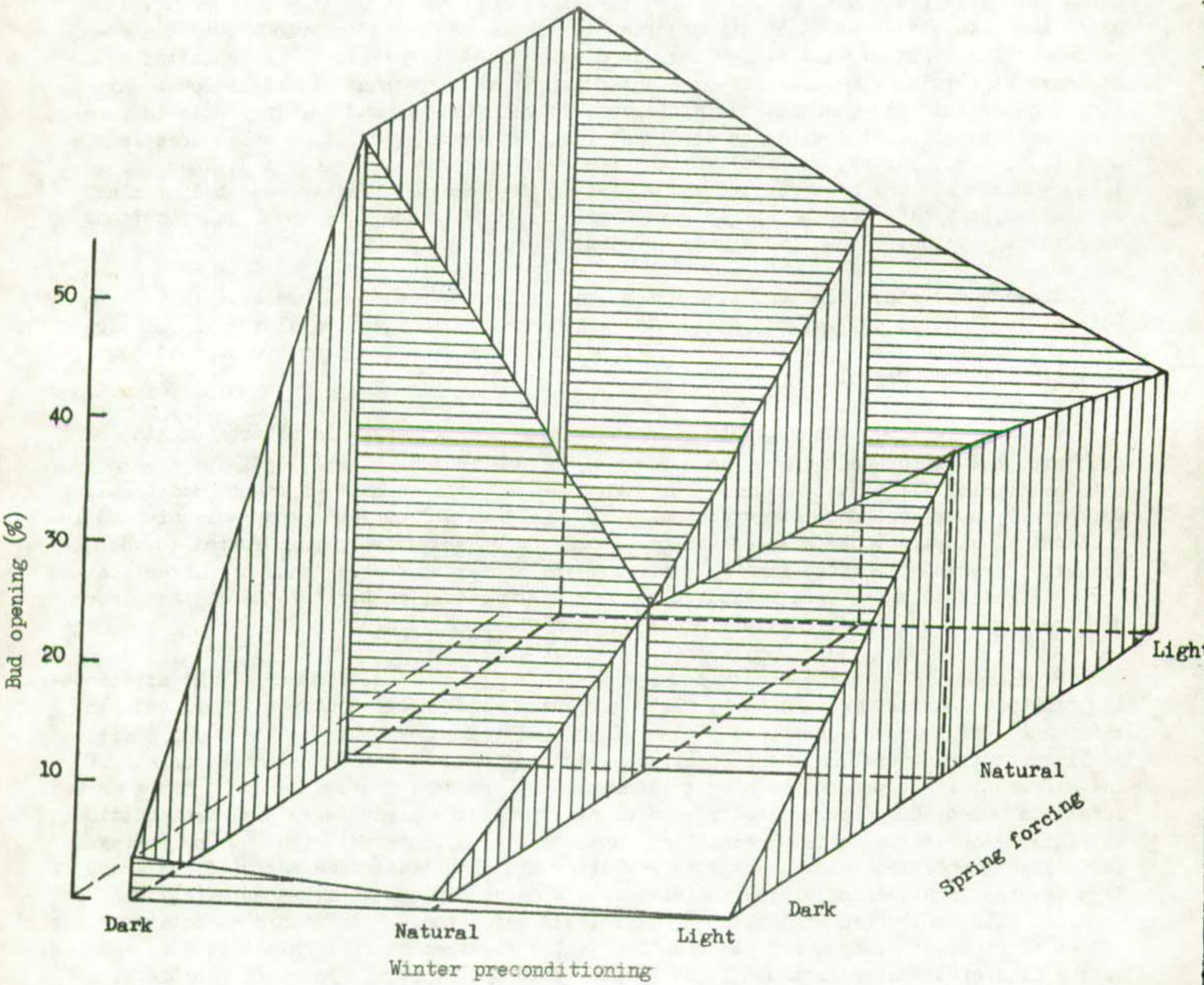


Fig. 11 The combined effect of different light conditions during winter chilling and spring forcing on lateral leaf bud break of Elberta peach under outdoor thermal conditions. (One-year-old potted plants; light preconditioning started on Jan. 29, 1964; start of spring forcing on March 2; bud break recorded on April 7. For details of the different light conditions, see text).

When plants which had been forced in the dark were kept for an additional 47 days in the dark, the percent bud break remained very low. However, when the plants were placed in natural outdoor light conditions after the dark forcing period, bud break increased markedly (Table 3).

As the light effect on bud burst was found also with young plants under outdoor conditions, we tried to obtain information about the behavior toward light of mature trees in the orchard.

TABLE 3

THE EFFECT OF AN ADDITIONAL LIGHT AND DARK FORCING PERIOD ON BUD BREAK OF INTACT ELBERTA PLANTS IN NATURAL THERMAL CONDITIONS (second forcing April 7 - May 24, 1964).

| Treatment | | | Percent bud break after total of | |
|---|---|---|---|---|
| preconditioning 32 days | forcing 35 days | 2nd forcing 47 days | 67 days | 114 days |
| dark | dark | dark | 3.8 | 6.2 |
| natural | dark | dark | 0.8 | 7.0 |
| light | dark | dark | 0.9 | 1.2 |
| natural | dark | natural | 0.8 | 65.8 |

One-year-old shoots, 12 per treatment, on six-year-old Elberta trees were covered with transparent or colored cellophane, and others were painted with black, white, and black covered with white plastic paint on March, 6 1964. Shoots left uncovered acted as control. Percent bud break was determined on March 24, and the temperature of the buds was recorded by means of thermocouples at mid-day on April 1, 1964. The results are presented in Fig. 12.

The variations in temperature among the different treatments make it difficult to distinguish between light and temperature effects, especially as the rise in the latter seems to be the primary factor for increased bud burst. The line connecting the control and the colorless cellophane treatment represents the assumed response to the thermal factor alone. A closer examination reveals, however, that the blue cellophane cover reduced (relatively) leaf and flower bud opening, while the green increased flower bud opening and the red increased leaf bud opening. These results obtained with sunlight conditions, confirm those obtained under artificial illumination in the laboratory (see Fig. 8).

Among the plastic paints, the white and the white or black seems to have some inhibitory effect on leaf bud opening but not on flower buds. This difference might point to darkening as the cause, which would be expected to reduce only leaf bud opening. However, the expected effect was not observed with the dark paint, possibly because of a thinner layer of paint applied, which did not eliminate light completely despite the black color.

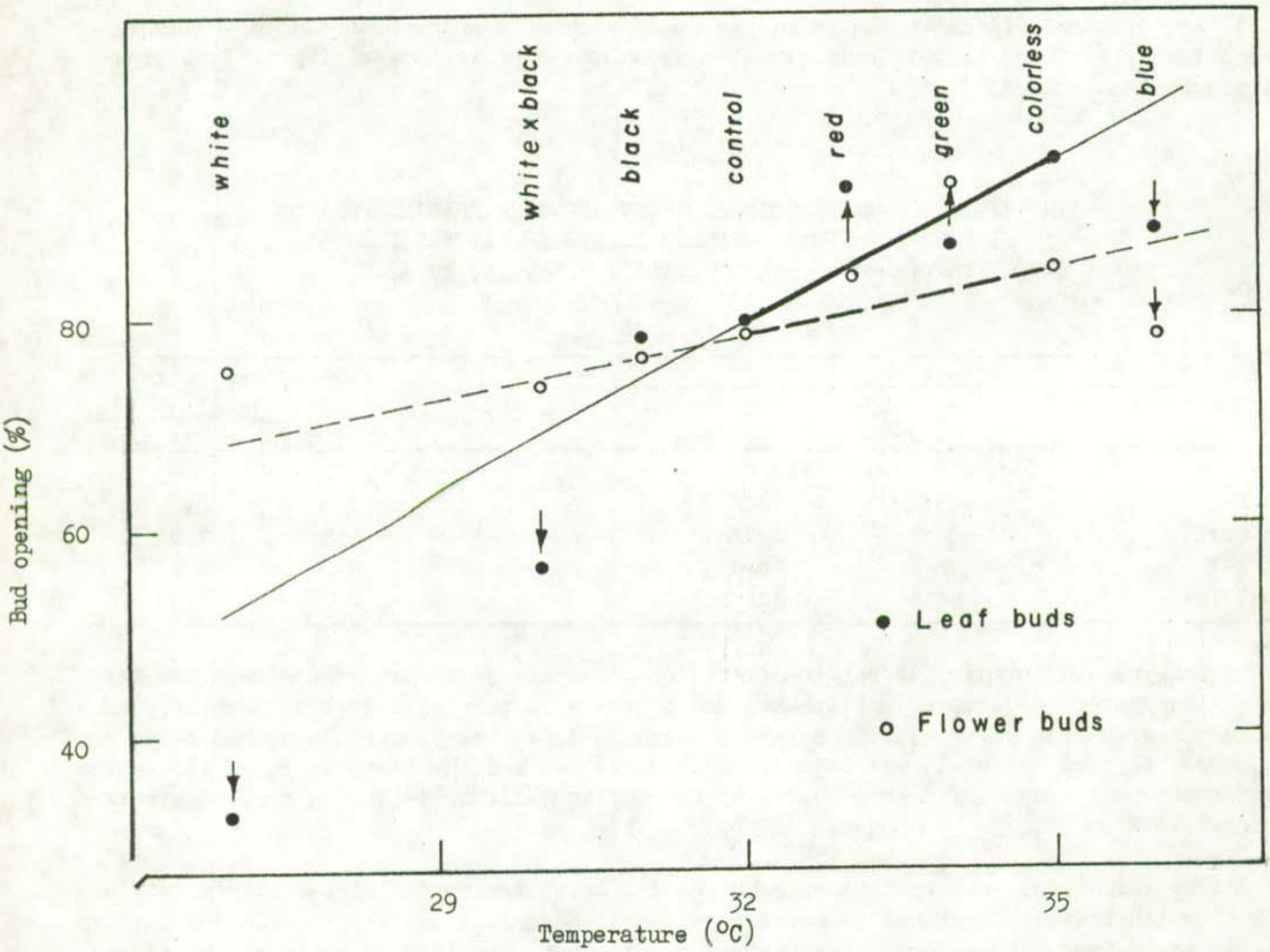


Fig. 12 The combined effect of temperature and light quality on leaf and flower bud opening of Elberta peach in the orchard. (Blue, green, red and colorless cellophane paper (4layers) and black, white, and black covered with white plastic paints; covering of shoots between Mar. 6 and Mar. 24 1964., temperature recorded on Apr. 1.)

Preliminary experiments were conducted in order to test the light effect on the bud break of cherry, apricot and grape shoots. No definite results could be obtained because of insufficient chilling of the plant material. With grapes, a rather strong increase in bud break was found due to far-red illumination. Red light, compared to darkness, caused a weak inhibition. These effects will have to be investigated in greater detail.

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שינוי משטר האור בתנאי חורף טבעיים, בבית-דגן (בתנאי קרור לא מספיקים), הראה שהחשכה באביב מונעת למעשה כל התעוררות, ושתוספת אור מעל לטבעי בזמן זה מעלה מאוד את אחוז ההתעוררות. נוסף לכך, נמצא, שהארה נוספת, ועוד יותר - תנאי חושך במשך החורף בלבד, הראו השפעה מעודדת על התעוררותם של פקעי עלים. בדיקות בתנאי שדה אישרו את התוצאות שנתקבלו בתנאי מעבדה מלאכותיים לגבי פעילות מיקטעים שונים, בספקטרום הנראה, על התעוררותם של פקעי עלים ופרי.

בחינה ראשונית של התופעה בעצי-פרי נשירים אחרים מצביעה על תגובה דומה בתפוח ובגפן.

# מחקרים בפיסיולוגית-התרדמה והתיחסותם לגידול עצי-פרי
(דו"ח 3)

מאת

מ"ר סמיש, ש' לביא, א' ארז

## תקציר

דו"ח זה הוא השלישי בסידרה והוא דן בהשפעות של גורמי הסביבה על תרדמה והתעוררות של פקעים בעצי פרי, ובמיוחד באפרסק.

נמצא, שבזן אלברטה יעילותה של טמפראטורה יומית מחזורית, הנעה בתקופת החורף בין 6-18 מ"צ, טובה יותר מאשר תנאי קור קבועים. לעומת זאת, בזן רד-הייבן, שווה יעילות הטמפראטורה היומית המחזורית לזו של תנאי קור קבועים, כשבסיס החישוב הוא שעות קור.

נמצא אישור לדרישה האובליגאטורית לאור של פקעי עלים, שצויינה בדו"ח הקודם. נראה, שהשפעת ההארה בתקופות קרור הנעות בין 44 ל-70 יום, ב-6 מ"צ, אינה מישתנה, כלומר - להארה יש השפעה אדיטיבית לקרור. כן נמצא קשר בין מחזורי הטמפראטורה וההארה.

בבדיקת השפעת ההארה במחזור יומי, בפרקי זמן קצרים וארוכים, על התעוררות פקעי עלים באפרסק נמצא, שכבר ל-1¼ שעות הארה ביממה יש תגובה חזקה ביותר, אם כי התעוררות מירבית נתקבלה בתנאי יום ארוך. עוד נראה, שפעולת הארה קצרה יעילה יותר כשהיא ניתנת במחזור עם חושך מאשר כשהיא ניתנת ברציפות.

בדיקת תגובתם של פקעי עלים באפרסק להארה במשך 96 שעות בלבד, בצבעי אור שונים, אישרה תוצאות שנתקבלו בעונה הקודמת בהארה ממושכת, כלומר - שאור אדום הוא המיקטע הפעיל באור הלבן, והן - שלאור כחול יש השפעת עיכוב מסויימת. האור האדום-רחוק, כשהוא ניתן מיד לאחר האדום, גורם לביטול פעולתו של האחרון, ומכאן המסקנה, שפיגמנט הפיטוכרום פעיל בריאקצית אור זו. תנאי הארה של יום קצר, בתוספת הארה קצרה בחצות הלילה, הביאו להתעוררותם של פקעי עלים ברמה הדומה למתקבלת בתנאי יום ארוך. תופעה זו מצביעה על האופי הפוטופריודי של התגובה לאור.

בדיקה השוואתית של התעוררות פקעים צדדיים (לטראליים), ופקעים אמיריים (טרמינאליים) בתנאי חושך ואור מראה, שעיכוב ההתעוררות בהעדר אור הוא חזק מאוד בפקעים הלטראליים וחלש יחסית בטרמינאליים, כך שבתנאי חושך מוחלטים יש התעוררות טרמינאלית ניכרת.

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המכון הלאומי והאוניברסיטאי לחקלאות
מכון וולקני לחקר החקלאות

האגף למטעים
המחלקה לעצי-פרי נשירים

# מחקרים בפיסיולוגית התרדמה והתיחסותם לגידול עצי-פרי

## (דו"ח III)

מאת

מ"ר סמיש, ש' לביא, א' ארז

המחלקה לפירסומים מדעיים
רחובות

בולטין מס' 96
תשכ"ה - 1965