Rapid #: -18911567

CROSS REF ID: **6084588**

LENDER: **SOI :: Morris Library**

BORROWER: **HUL :: Widener Library**

TYPE:	Article CC:CCL
JOURNAL TITLE:	Proceedings of the American Society for Horticultural Science
USER JOURNAL TITLE:	Proceedings of the American Society for Horticultural Science
ARTICLE TITLE:	The effect of intermittent warm and cold periods on breaking the rest period of peach leaf buds
ARTICLE AUTHOR:	
VOLUME:	66
ISSUE:	
MONTH:	
YEAR:	1955
PAGES:	87-92
ISSN:	
OCLC #:	5966535

Processed by RapidX: 4/7/2022 3:30:40 PM

The Effects of Intermittent Warm and Cold Periods on Breaking the Rest Period of Peach Leaf Buds[1]

By J. P. Overcash and J. A. Campbell, *Mississippi Agricultural Experiment Station, State College,* and *Crystal Springs, Miss.*

The problem of breaking the rest period is of vital concern every year in the southern fringe of the commercial-peach-growing areas in the eastern United States and in California. Prolonged dormancy, which is usually defined as delayed flowering and foliation due to inadequate breaking of the rest period, occurs to some extent on certain varieties with long-chilling requirements almost every year in areas south of the present commercial peach districts. Chilling is recognized as the chief means of breaking the rest period of deciduous plants (2, 3, 5, 8, 9, 10, 11). Moderate winter temperatures which are inadequate to break the rest have been widely studied in areas where delayed foliation occurs with some frequency on many peach varieties.

Certain factors which affect the chilling temperatures to which peach trees are normally exposed have been found to influence the rest period. Shade in winter has been effective in helping to break the rest period (2, 3, 7, 10, 11). It is commonly believed that the primary influence of shade is to lower the daytime temperature, thus exposing the plant to more hours of effective chilling. This influence of shade is undoubtedly important; however, there is some evidence that high temperatures occurring intermittently during the chilling period not only depress the cumulative effect of chilling but also tend to counteract the chilling which has already taken place (1, 10). It has been observed that the temperatures of peach twigs in bright sunlight are often considerably higher than the surrounding air (7, 11).

At Crystal Springs, Mississippi, in the effective winter-chilling period, November 1 to February 15 (8), some winters there is a total of 400 to 500 or more hours of air temperatures, in the shade, at 65 degrees F or higher. If high temperatures, interspersed between chilling temperatures during the winter, counteract the effectiveness of some of the chilling, then the number of chilling hours required to break the rest period in this area might be considerably higher than in areas where the exposure to cold is more nearly continuous.

This paper reports the results of a study to determine the effects of alternating high temperatures with cold temperatures on breaking the rest of leaf buds of small trees of two varieties. The two varieties chosen were Sunhigh with a short chilling requirement; and Redhaven, with a long chilling requirement. Weinberger (8) studied the chilling requirements of many varieties and states that Sunhigh needs 750 hours of chilling at 45 degrees F or lower to break the rest period of both flower and leaf buds, and Redhaven requires 850 hours for flower buds and 950 hours for leaf buds to grow under normal outdoor chilling at Fort Valley, Georgia. In this investigation these varieties were chosen because Sunhigh trees following the very mild winter of 1949–

[1]Journal Article 478, Mississippi Agricultural Experiment Station. Received for publication April 12, 1955.

50 at Crystal Springs, Mississippi, were only slightly delayed in blossoming and foliation, whereas Redhaven trees were very seriously affected by prolonged dormancy.

Materials and Methods

One-year-old trees which had been selected for uniformity and were two to three feet tall were obtained from a commercial nursery as soon as the leaves dropped in the fall of 1952. These trees were planted in a loam soil in standard 8-inch clay pots. They were then kept continuously in a warm greenhouse until the chilling treatments were started.

One tree was considered a plot and there were four replications. Two methods of chilling were used, intermittent and continuous. Intermittent chilling consisted of exposing the trees to sixteen hours of temperature at 39 degrees F in a refrigerated room during the night, and eight hours of temperatures at 70 degrees F or more during the day in the greenhouse. They were moved to and from the greenhouse at 8:00 a.m. and 4:00 p.m. Continuous chilling consisted of exposing the plants continuously in a refrigerator at 39 degrees F for a period considered sufficient to fill the chilling hour requirement.

Two chilling periods were used for each variety and each chilling treatment, a relatively short period of 750 hours, and a relatively long period of 950 hours. Thus eight treatments were involved. The starting date for each method of chilling was chosen so that the chilling periods would end for all varieties and treatments on the same day.

After the completion of the chilling periods all trees were moved to a warm greenhouse with minimum night temperatures of 60 degrees F, and their subsequent growth was studied. Leaf bud counts were made at weekly intervals on each tree which had begun to grow. Buds were counted when they were one-eighth of an inch or more in length.

In the late spring of 1953 the trees were planted in the soil under a lath shade and given conditions which favored moderate growth during the summer. In early November 1953, after the leaves had fallen, these trees were dug and placed in wooden boxes about 11 inches square and 12 inches deep. At this time these trees had an average height of 4 to 5 feet. The experiment was repeated in the winter of 1953–54 under the same conditions that were used during the previous winter.

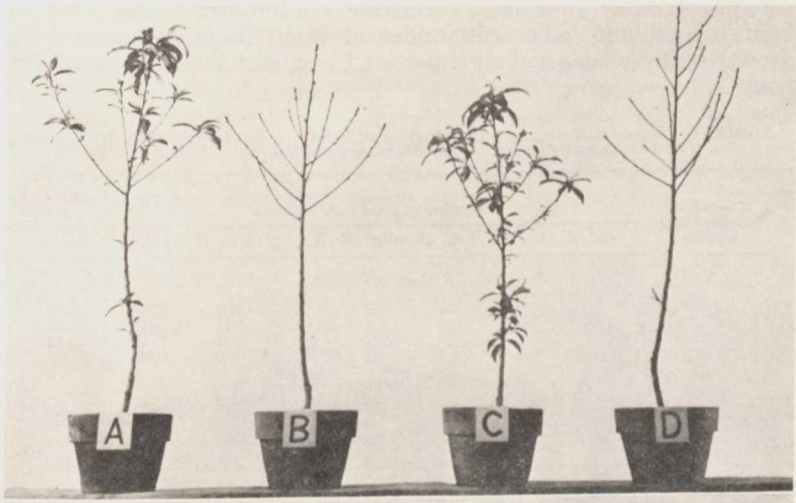
Results and Discussion

The results of continuous and intermittent chilling on leaf growth in 1952–53 are presented in Table 1. The effects are illustrated in Figs.

TABLE 1.—Average Number of Growing Leaf Buds per Tree on Various Dates in 1953 Experiments. Chilling Ended January 24.

Hours and method of chilling	Jan. 24	Jan. 29	Feb. 14	Feb. 28	Mar. 14	Mar. 28
		Redhaven				
750 continuous	0	2	14	18	18	35
750 intermittent	0	0	0	1	5	18
950 continuous	0	1	32	36	36	50
950 intermittent	0	0	0	2	14	23
		Sunhigh				
750 continuous	2	6	15	15	25	25
750 intermittent	0	0	1	2	5	20
950 continuous	3	5	28	28	44	45
950 intermittent	0	0	6	7	8	28

1 and 2. It is evident that the continuous chilling either for 750 or 950 hours was most effective in breaking the rest period of the leaf buds of both Redhaven and Sunhigh trees. The trees receiving continuous chilling not only began to grow earlier (see counts on February 14), but also produced leaves at the greatest number of growing points, as indicated by the counts on March 28. Figs. 1 and 2 show the effective-



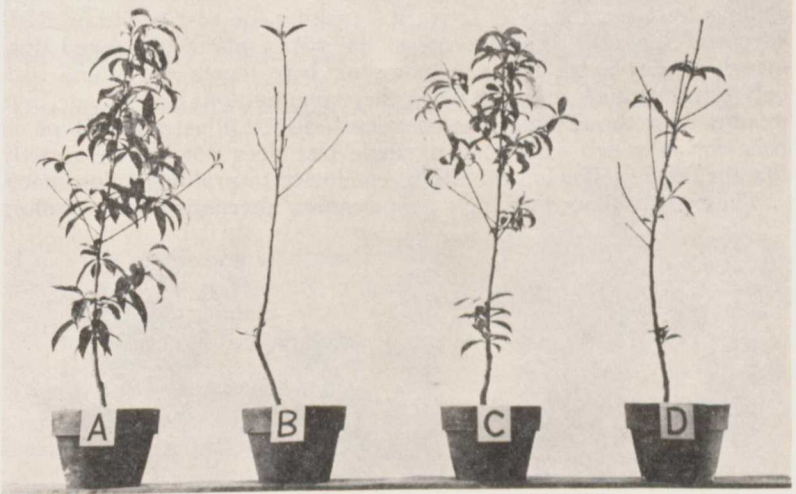


FIG. 1. (Upper) Redhaven peach trees on February 24, 1953, one month after the chilling periods at 39 degrees F ended. A, 750 hours continuous chilling; B, 750 hours intermittent; C, 950 hours continuous; D, 950 hours intermittent.

FIG. 2. (Lower) Sunhigh peach trees, on February 24, 1953, one month after the chilling periods at 39 degrees F ended. A, 750 hours continuous chilling; B, 750 hours intermittent; C, 950 hours continuous; D, 950 hours intermittent.

ness of continuous chilling in breaking the rest. Chilling treatments of 950 hours were more effective than 750 hours in breaking the rest of the leaf buds as measured by the total number of buds which grew.

The results in the 1953–54 experiments are similar to the results of the 1952–53 tests. The data in Table 2 show that more leaf buds grew following continuous chilling, and also a greater length of new shoots was produced by June 18. These data also indicate, again, that 950 hours of chilling, either continuous or intermittent, stimulated the growth of more buds and a greater total length of shoots than did 750 hours.

TABLE 2.—AVERAGE NUMBER OF GROWING LEAF BUDS AND LENGTH OF NEW SHOOTS PER TREE ON VARIOUS DATES IN 1954 EXPERIMENTS. CHILLING ENDED JANUARY 7.

Hours and method of chilling	Number of growing leaf buds							Total length of shoots June 18 (inches)
	Jan. 8	Jan. 29	Feb. 26	Mar. 26	Apr. 23	May 21	June 18	
				Redhaven				
750 continuous.....	0	0	20	76	77	109	109	86
750 intermittent...	0	0	0	4	10	44	64	18
950 continuous.....	0	0	29	120	121	121	121	262
950 intermittent...	0	0	11	32	38	60	108	67
				Sunhigh				
750 continuous.....	0	28	56	56	56	56	56	183
750 intermittent...	0	0	2	6	10	22	27	54
950 continuous.....	2	75	88	88	88	88	88	379
950 intermittent...	0	0	0	1	16	25	39	131

Figs. 3 and 4 show that both 750 and 950 hours of intermittent chilling were not totally effective in breaking the rest of either Redhaven or Sunhigh, because some of the symptoms of prolonged dormancy are displayed. These include some bare shoots and others with only terminal buds growing when these photographs were made, five months after the chilling was completed. Fig. 5 illustrates a type of behavior in which sometimes a single tree does not behave exactly like the others following conditions conducive to prolonged dormancy.

The results show that high temperatures alternating with chilling

FIG. 3. Redhaven peach trees, on June 5, 1954, five months after the chilling periods at 39 degrees F ended. A, 750 hours intermittent chilling; B, 750 hours continuous; C, 950 hours intermittent; D, 950 hours continuous.

temperatures counteracted some of the cumulative effect of chilling in breaking the rest of leaf buds of both Redhaven and Sunhigh varieties. This is particularly evident when Sunhigh trees, which normally should have their rest broken by 750 hours of chilling, still showed signs of prolonged dormancy after a total of 950 hours of chilling at 39 degrees F which was interrupted daily by eight hours of warm air temperatures at 70 degrees F or higher. Bennett (1) found this to be true in a somewhat similar experiment with the Hardy variety of pear. Weinberger (10) found that brief periods of high temperatures on sunny days in December also counteracted some of the normal chilling influence of cold weather under orchard conditions with Sullivan Elberta flower and leaf buds on bearing trees.

The effectiveness of high air temperatures and consequently higher twig temperatures on bright, sunny days in counteracting a certain amount of the chilling influence of low temperatures is offered as a

FIG. 4. Sunhigh peach trees, on June 5, 1954, five months after the chilling periods at 39 degrees F ended. A, 750 hours intermittent chilling; B, 750 hours continuous; C, 950 hours intermittent; D, 950 hours continuous.

partial explanation of prolonged dormancy in Texas by Denman (6). He found that the rest period of most of the common peach varieties was not adequately broken by an accumulation of over 1000 hours of chilling temperatures (air) by February 15. Similarly the rest of many peach varieties in the winter of 1951–52 at Crystal Springs, Mississippi, was not broken by the cumulated hours of chilling which had been indicated as effective by Weinberger (8) at Fort Valley, Georgia.

Yarnell (12), Weinberger (8), and Cooper (4) have found that the natural chilling requirement

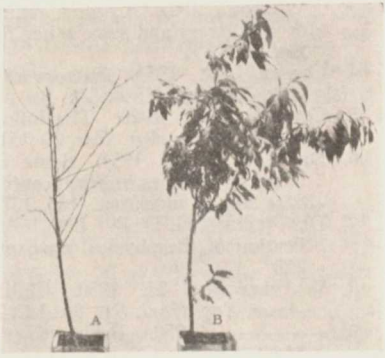


FIG. 5. Redhaven peach trees photographed June 10, 1954, twenty-two weeks after being placed in a warm greenhouse on January 7. A, 950 hours of intermittent chilling; B, 950 hours of continuous chilling.

of a variety varies from place to place and year to year. Variable amounts of high temperatures interspersed with the chilling may be a partial explanation of the reported differences which are especially wide.

There is evidence in the data and illustrations presented that the rest period of some buds on a tree is different from others; and, that higher numbers of chilling hours causes the rest of a greater number of buds to be broken.

Summary

Studies were made on the influence of an eight-hour warm period daily along with 16 hours of cold on breaking the rest period of small Redhaven and Sunhigh peach trees.

Continuous chilling broke the rest period of more leaf buds than alternating warm and cold periods even though the total hours of chilling temperatures were the same.

Periods of high temperature interspersed with periods of low temperature counteracted some of the cumulative chilling influence of low temperatures.

A chilling treatment of 950 hours at 39 degrees F, either continuous or intermittent, was more effective than 750 hours in stimulating leaf buds of both varieties to grow.

Both Redhaven and Sunhigh trees subjected to 950 hours of chilling temperatures at the rate of 16 cold hours (39 degrees F) and 8 warm hours (70 degrees F) showed symptoms of prolonged dormancy.

Literature Cited

1. Bennett, J. P. 1950. Temperature and bud rest period. *Calif. Agr.* 4: 11, 13, 15.
2. Chandler, W. H., and D. S. Brown. 1951. Deciduous orchards in California winters. *Calif. Agr. Expt. Sta. Cir.* 179.
3. Chandler, W. H., M. H. Kimball, G. L. Philip, W. P. Tufts, and G. P. Weldon. 1937. Chilling requirements for opening of buds on deciduous orchard trees and some other plants in California. *Calif. Agr. Expt. Sta. Bul.* 611.
4. Cooper, J. R. 1953. Factors affecting winter injury to peach trees. *Ark. Agr. Expt. Sta. Bul.* 536.
5. Coville, F. V. 1920. The influence of cold in stimulating the growth of plants. *Jour. Agr. Res.* 20:151–160.
6. Denman, T. E. 1954. Some factors affecting the chilling requirements of peach varieties in north central Texas. *Proc. Assoc. So. Agr. Workers, 51st Ann. Convention:* 136, 137.
7. De Villiers, G. D. B. 1940. A micro-climatic study: Shade and its modification of the physical environment. *South Africa Dept. Agr. Sci. Bul.* 215.
8. Weinberger, J. H. 1950. Chilling requirements of peach varieties. *Proc. Amer. Soc. Hort. Sci.* 56: 122–128.
9. ———. 1950. Prolonged dormancy of peaches. *Proc. Amer. Soc. Hort. Sci.* 56: 129–133.
10. ———. 1954. Effects of high temperatures during the breaking of the rest of Sullivan Elberta peach buds. *Proc. Amer. Soc. Hort. Sci.* 63: 157–162.
11. Weldon, G. P. 1934. Fifteen years' study of delayed foliation of deciduous fruit trees. *Calif. State Dept. Agr. Mo. Bul.* 23: 160–181.
12. Yarnell, S. H. 1940. Texas studies on the cold requirements of peaches. *Proc. Amer. Soc. Hort. Sci.* 37: 349–352.