Temperature and Bud Rest Period

effect of temperature and exposure on the rest period of deciduous plant leaf buds investigated

J. P. Bennett

The following article is being reprinted from the November 1949 issue of California Agriculture *to rectify the omission of an illustration important to the clarity of the content.*

Breaking the rest period of leaf buds of deciduous plants is generally admitted to be brought about mainly by the low temperatures of late fall, winter and early spring.

The amount of exposure required to fully break the rest varies with different plants and with the temperature. If the exposure is too short or the temperature not low enough—or both—incomplete breaking occurs; fewer buds grow, and growth is relatively less vigorous than on normal plants.

The rest of many plants may be effectively broken by cold storage. The requirements are a temperature between freezing and about 45° F and a period of continuous exposure of two to three months.

If plants which have clearly recognizable rest periods and are in the resting state are held continuously at temperatures of 60° F to 80° F, the rest may be prolonged for many months and sometimes for a year or more.

In the intermediate temperature range —45° F to 60° F—the results of continuous exposure vary with the kind of plant, but in general, an incomplete ending of the rest occurs.

A relatively short exposure to excessively high temperature—a few hours or days at 110° F to 130° F—will often start resting buds into growth. How the different temperature levels prolong or bring about the ending of the rest condition is still unknown.

The relation of exposure for varying periods to a temperature very effective in breaking the rest is shown in the larger illustration.

The plants shown in the photograph on the right are one-year-old Hardy pear trees bearing only leaf buds. They were transplanted in November from an outdoor nursery to a greenhouse with a temperature range from 60° F to about 90° F, where they remained completely dormant for many months. No buds grew until the following August, and then only a portion of the terminal buds.

At intervals of several days, beginning in April, a few of the dormant trees were transplanted into peat moss and placed in a cold storage room at 37° F. At the end of 81 days, the ten lots were removed to the greenhouse. Two months later one tree from each lot was photographed with one which had remained continuously in the greenhouse.

The picture shows that trees which had been stored at 37° F continuously for 56 to 81 days opened most of their buds, as they do after a normal winter outdoors. With decreasing length of cold treatment below 56 days, an increasing proportion of buds remained inactive until at no exposure and at 10 days exposure only two injured buds grew feebly.

The trees which were in the cold room from 19 to 42 days resemble typical examples of delayed foliation found in the orchard after a too warm winter.

The results described above were obtained with continuous storage at 37° F.

Trees outdoors are subjected to widely varying climatic conditions.

The temperatures to which they are exposed are, part of the time, favorable for breaking the rest, part favorable for prolonging it, and part in the intermediate range. It is difficult to estimate how large an influence each temperature level may have upon the subsequent behavior of resting buds.

To get a basis for judging the possible effect of daily temperature changes, the following experiment was carried out, based upon some results obtained in Europe with water plants.

The trees used were essentially the same as used in the previous work, one-

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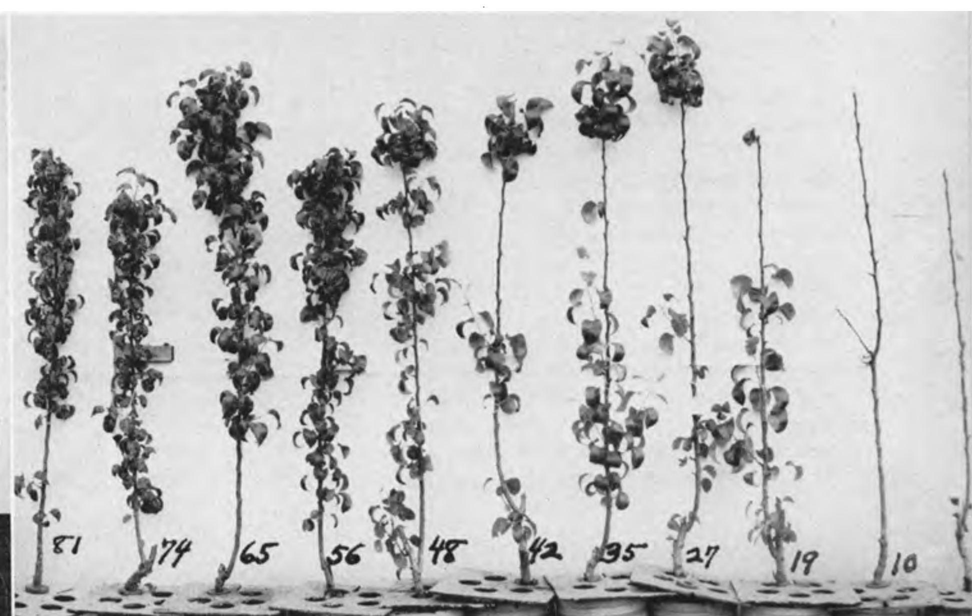
LEFT: Hardy pear trees held at 37° F: Lot 1, 71 days continuously; Lot 4, 52 days continuously; Lot 2, 71 days, 18 hours per day at 37° F, six hours per day at 73° F in dimly lighted rooms; Lot 3, 71 days, 18 hours per day at 37° F in unlighted room, six hours per day outdoors at 64° F in daylight, of which 76% was direct sunlight. Photographed one month after return to greenhouse. RIGHT: Hardy pear trees held continuously at 37° F for the number of days indicated by numerals. Photographed two months after return to greenhouse.



Alfalfa in Chick Rations

possible control of growth depressing effect of alfalfa indicated by addition of cholesterol to diet of chicks

D. W. Peterson

The following progress report is condensed from the full technical report to be published in a forthcoming issue of Journal of Biological Chemistry.

Evidence obtained in feeding tests indicates that the depressing effect of dehydrated alfalfa on the growth of chicks can be counteracted largely by the inclusion of cholesterol—a type of crystalline alcohol—in alfalfa-containing rations.

It appears that the growth depressing effect is due to a naturally occurring substance which in some unknown manner produces a toxic effect on chicks.

The deleterious effect of alfalfa meal is present in the fresh alfalfa—as determined by drying fresh frozen alfalfa and feeding it—but it is not due to the fiber present, nor to the mineral constituents.

Most of the inhibitory effect on growth can be removed by exhaustive extraction of the alfalfa meal with hot water. The residue so produced has little growth-depressing action, whereas the water extract produces marked inhibition of growth.

Precipitates—or fractions—from the extractions were prepared by chemical process for inclusion in growth tests.

Growth Tests

Biological tests employed to detect the presence or absence of the growth-inhibiting factor were growth tests on seven- to 14-day-old Single Comb White Leghorn chicks that had been maintained previously on a standard stock diet.

The chicks were selected for uniformity of weight and rate of growth and were maintained on the experimental diets for periods varying from two to three weeks.

A basal ration was formulated from practical feedstuffs. Alfalfa meal at a 20% level was included in the ration and fed to one group of chicks. Other groups received the basal ration to which were added precipitates obtained by chemical fractionation of a water extract of alfalfa meal. All were compared with a group fed the basal ration containing no alfalfa meal and with a standard stock diet. One fraction, insoluble in an alcohol acetone solution, had marked growth depressing properties.

All inhibitory fractions foamed strongly. This characteristic suggested the presence of saponins—compounds present in many plants which have foam producing properties. Some of these compounds are toxic and this suggested an explanation of the growth inhibiting effect of alfalfa meal on chicks.

Saponins react with sterols—crystalline alcohol compounds—to form addition compounds which have lost a property peculiar to saponins—the ability to hemolyze—dissolve—red blood cells.

To test the possibility that a sterol might counteract the growth depressing agent, cholesterol, a sterol from animal sources, was added to the alfalfa containing diets.

The results of the tests indicated that cholesterol counteracted the growth depressing action of alfalfa meal and of the various inhibitory fractions obtained from alfalfa meal.

It appears probable that the growth depression is due to saponins, since all fractions producing growth depression had a hemolytic action which was prevented by cholesterol. It cannot be stated without qualification, however, that saponins are responsible for the growth inhibiting properties of alfalfa meal until they are isolated in pure form from alfalfa and shown by feeding tests to cause growth depression.

While it is not feasible to feed cholesterol in a practical ration, the type of information obtained in these studies leads to a probability that a practical means can be found for counteracting the growth inhibitor of alfalfa meal.

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The above progress report is based on Research Project No. 677-D3.

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year-old Hardy pears bearing only leaf buds, brought into the warm greenhouse in November and used while still in the resting condition the following spring.

On April 1st three lots of ten trees were transplanted into peat moss and placed in cold storage at 37° F. Lot 1 was held continuously in the cold room for 71 days. Lot 2 was daily removed from the cold room and placed in a dimly lighted room at a mean temperature of 73° F for about six hours, then returned to the cold room. Lot 3 was likewise daily removed from the cold room and placed outdoors where the mean temperature was 64° F and it received direct daylight for about six hours before return to the cold room.

Of the total outdoor exposure 76% was recorded by the United States Weather Bureau as sunshine, 24% as cloudy.

On April 20th a fourth lot of ten trees was placed in the cold room and held there continuously for 52 days.

On June 11th all trees were planted in the greenhouse. On June 20th a few buds were growing on lots 1 and 4 but none on lots 2 and 3. Visible growth of a few buds on the latter two lots did not occur until June 27th. In the succeeding days the number of growing buds increased on all lots of trees, but many more grew on lots 1 and 4 than on lots 2 and 3. The maximum numbers of growing buds were reached on July 3d on lots 1 and 4, but not until July 15th on lots 2 and 3. The final number of buds which grew were as follows: lot 1, 84%; lot 2, 29%; lot 3, 50%; lot 4, 72%; of the total buds present.

It is clear that the treatments applied to lots 2 and 3 both retarded the rest breaking process in comparison with those applied to lots 1 and 4. The retardation expressed itself in two ways: in the smaller numbers of buds growing and in the slowness with which they started growth. In the smaller illustration are shown two trees from each lot, the one with least and the other with most buds growing. The trees in lots 2 and 3 resemble those in the larger photograph which had received too short cold treatment—less than 50 days.

Lots 2 and 3 received a cumulative exposure at 37° F equivalent to 52 days, the same as lot 4 received without interruption.

It is apparent that a few hours daily warm treatment partly offset the effect of 18 hours daily cold treatment.

Although lots 2 and 3 were both

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Bud Moth on Prunes

comparative effectiveness of spray and dust as controls studied in tests

___ Arthur D. Borden, Harold F. Madsen and Stanley Benedict

A technical experiment is covered by the following progress report. Users of organic phosphates, such as parathion, are urged to follow carefully established precautions for handling the material.

Spray applications of Parathion and DDD gave better control of the bud moth—*Spitlonana ocellana*—attacking prunes in the Santa Clara Valley, than did dust applications in tests made during the 1949 season.

A 25-acre block of 15-year-old French prunes was divided into 10 plots—each plot 10 tree rows wide and 23 tree rows long—for a semi-commercial test of the efficiency of two of the materials found most promising in control in the 1948 experiments. All of the spray and dust applications were made by the grower with equipment in use on that orchard. The treatments were made in replicate—two plots per treatment—and included the following:

25% wettable Parathion spray at a dosage of one pound to 100 gallons of water.

50% wettable DDD spray at a dosage of three pounds to 100 gallons of water.

5% DDD dust mixture at a rate of 40 pounds an acre.

2% Parathion dust mixture at a rate of 33 pounds an acre.

Untreated plots which received no spray chemicals.

The equipment employed in the application of the spray chemicals was an air carrier type of sprayer discharging 30,000 cubic feet of air a minute, with a full peripheral discharge through 28 nozzles with .078 disc openings. The sprays were applied by the low volume method averaging 1.9 gallons a tree in the first application—April 20th—and 2.6 gallons a tree in the second application—June 14th.

A mist duster having a double fishtail discharge was employed for the application of the dust mixtures. The dust applications averaged .43 pound a tree. All applications were made in the late evening when there was no wind.

A pre-spray count made March 14th of the number of hibernaculum—protective covers for overwintering larvae—found at the base of 200 fruit spurs selected at random from each plot showed an average of 27 hibernaculum a sample and a very even distribution of the infestation in all plots.

The first application was made April 20th when the fruit was largely in the jacket period. The timing of the second application was determined by randomized counts of the number of hatched eggs of the new brood of moth as found in the untreated plots. On June 14, 69% of the eggs had hatched; 11% were in the black-spot stage ready to hatch, and 21% were not hatched. The second application was applied that evening.

A post-treatment count was made April 28th, of 200 leaves selected at random from each treatment.

Counts of Bud Moth Larvae on Leaves in Post-Spray Count of April 28

Treatment	Leaves examined	Living larvae	Dead larvae	Empty cases *	Pupae
Parathion					
spray	.200	0	90	109	1
dust	.200	2	67	130	1
DDD					
spray	.200	12	19	165	4
dust	.200	58	9	128	4
No treatment	.200	83	0	13	4

* Empty cases may indicate the larvae were destroyed and dropped out, or may have migrated to new quarters.

After the damage to the leaves from the new brood of larvae was apparent, randomized counts of the number of injured leaves that could be seen from the ground were made on an equal number of trees in each plot.

The results of this count made July 26th showed the average number of damaged leaves per tree from each treatment to be: Parathion spray, 0.64; Parathion dust, 2.66; DDD spray, 0.64; DDD dust, 13.5 and Untreated, 32.46.

Randomized counts of mature fruit on the ground at the first picking—August 15th–16th—and at a later picking—August 28th—showed the percentages of bud moth injured fruit.

Percentage of Bud Moth Injured Fruit at Harvest

Treatment	August 15	August 28	Average for both pickings
Parathion			
spray	2.2	1.0	1.6
dust	4.4	3.0	3.7
DDD			
spray	1.3	0.4	0.8
dust	7.6	2.3	5.0
No treatment	22.1	12.5	17.3

Residue analyses were run on fresh fruit from each plot and on the dried fruit after dipping and dehydration.

Residue Analyses of Fresh and Dried Fruit Following the Control Treatments

Treatment	Parts per million on Fresh fruit	Parts per million on Dried fruit
Parathion		
spray	.012	.006
dust	.006	.000
DDD		
spray	.680	.710
dust	.270	.290

The spray applications gave better control than did the dusts with both of the spray chemicals tested. Although Parathion sprays and dusts show a higher initial toxicity to the larvae, the longer residual value of DDD as a spray makes this material equally effective.

Both of these materials are effective in the control of bud moth but spider mites may become a problem when DDD is used. Parathion is effective against spider mites and will also control mealy plum louse if present at the time of applying the spray.

Parathion presents no residue problem on fresh or dried fruit, while the spray residue of DDD may or may not be a problem depending upon the allowable tolerance.

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strongly retarded in comparison with lots 1 and 4, nearly twice as many buds grew on lot 3 as on lot 2.

The average temperature outdoors during the daily warm treatment of lot 3 was 9° F lower than that to which lot 2 was subjected. This difference in temperature may have caused the difference in behavior, but there is also the possibility that the strong summer sunlight may have stimulated growth of buds on lot 3. Strong radiation such as X rays in suitable dosage has been shown to break the rest of buds, and some evidence exists that ordinary light shortens the rest of certain buds. In the orchard it has been generally believed that much direct sunlight during the winter days tends to prolong the rest because it raises the temperature of twigs and buds somewhat.

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The part that light of varying intensity may play in retarding or hastening the ending of the rest is still not very clear. It may at winter intensities and duration be a retarding influence and become a stimulating influence at the higher intensities and longer duration of spring and summer.

The gardner and orchardist in regions of mild winters is thus confronted with a rather complicated situation involving temperature, light, variation of response of different kinds of plants, and possibly other factors, all of which affect spring growth. It appears clear from experience, however, that shade in winter is beneficial for plants with strong rest periods. It seems a reasonable deduction from the experimental results described above that plants subjected to fluctuating outdoor conditions may require a longer exposure to break the rest of buds than would be required under continuous low temperature.

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The above progress report is based on Research Project No. 989.

PIPE

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fabrication and installation procedure that should largely eliminate such failure at no appreciable increase in cost.

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The above Progress Report is based on Research Project No. 860.

SOILS

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applied fertilizer could be expected—provided other elements were not limiting.

No-nitrogen yields above 50% indicate high nitrogen supplies and little chance of field response to fertilizer.

Soils giving a no-phosphorus yield of 20% or less are so low in available phosphorus that they will, as a rule, produce a field response to applied fertilizer where other nutrient elements, specific soil conditions and water are not restrictive.

Phosphate responses in the field were especially noticeable during the cooler seasons of the year.

Soils producing no-phosphorus yields above 30% probably will not justify phosphate fertilization.

Low phosphate levels appear to be widespread in California, especially in hardpan soils and in the soils in the hills and mountains.

In contrast, the recent alluvial soils are somewhat better supplied with available phosphorus and have the additional advantage of having great depth which provides a large nutrient reservoir.

Available phosphorus in soils with either pronounced acid reaction or with pronounced basic—alkaline—reaction tends to be in low supply. Soils which are neutral or with only slight acid or alkaline reactions are, on the average, better supplied with available phosphorus.

Of the 105 soils tested which had a pH—the measurable acidity and alkalinity—of below 5.9, which indicates strong acidity, 79% were low in available phosphorus.

Of the 20 soils tested which had a pH of above 8.3—markedly alkaline—80% were low in available phosphorus.

Of 116 soils slightly off neutral only 26% were found to be low in available phosphorus.

Nearly all of the soils investigated appear to be well supplied with potash for the requirements of the crops used in this study.

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DAIRY FARM MANAGEMENT IN CALIFORNIA, by Arthur Shultis and G. E. Gordon. Ext. Cir. 156, September, 1949.

SELECTIVE WEED KILLERS, by Alden S. Crafts and W. A. Harvey, Ext. Cir. 157, September, 1949.

GENERAL-CONTACT WEED KILLERS, by Alden S. Crafts, Ext. Cir. 137, revised October, 1949.

GROUND WATER IN CALIFORNIA—The Present State of Our Knowledge, by S. V. Ciriacy-Wantrup and Patricia McBride Bartz. A special publication by the Giannini Foundation which is available only by addressing a request to the Agricultural Information Office, 22 Giannini Hall, University of California, Berkeley 4, California. The publication is free.

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