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## Effect of Temperatures Above and Below Freezing on the Breaking of Rest in the Latham Raspberry<sup>1</sup>

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As a part of the raspberry hardiness investigations carried on at the University of Minnesota it was thought that it would be of interest to determine the effect, if any, of intensity of cold upon the breaking of the rest period in the Latham raspberry. By rest period is meant the period in the cycle of perennial plants when they will not grow, although conditions may be favorable for their growth. This is apart from dormancy when the growth of the plant is stopped because of unfavorable external conditions such as low temperature or lack of water.

The methods used in this study were adapted from the methods used by Brierley and Landon (1) to determine the length of rest in the Latham raspberry. Canes were cut in the field and were placed in containers with water just covering the butts of the canes. Care was taken to insure that no air got into the conducting vessels of the canes to interrupt the conduction of water upward. The canes were placed in a cool greenhouse and notes taken on their development to determine the depth or intensity of rest. This was indicated by the length of time required for the buds to begin to grow. The beginning of growth was recorded at the time the bud scales separated so the tip of the first true leaf could be seen on several buds on at least three of the four canes in a sample. It was considered that rest was broken when growth started in 9 days as later samples still required that length of time to begin growth.

In this study a large number of canes were cut October 14 and stored with their butts in water at 37.4 degrees F and 26.6 degrees F. The cold rooms in which the canes were stored were maintained within one degree of the stated temperature. Samples were taken from this storage on October 21 and 28 and thereafter at 2-day intervals. Notes were taken and the water changed in the containers every 2 days also.

A third lot of canes was collected October 21 and were held at temperatures alternating between 26.6 and 37.4 degrees F. It was held at the lower temperature for 8 hours and the higher temperature for 16 hours each day.

The results of these experiments may be seen in Fig. 1. Of the canes stored at 37.4 degrees F the first sample took 21 days for growth to start. The time required for growth to start gradually decreased through successive samples until after 37 days of exposure to this temperature rest was broken. From the second lot stored at 26.6 degrees F, however, the first sample did not start to grow until it had been 44 days in the greenhouse. Rest was not broken in this lot until the canes had been exposed to 26.6 degrees F for 41 days. The canes in the third lot exposed to alternating temperatures took longer to start and required a longer exposure to low temperature to break the rest than either of the lots exposed to constant low temperature.

<sup>1</sup>Paper No. 2364 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota.

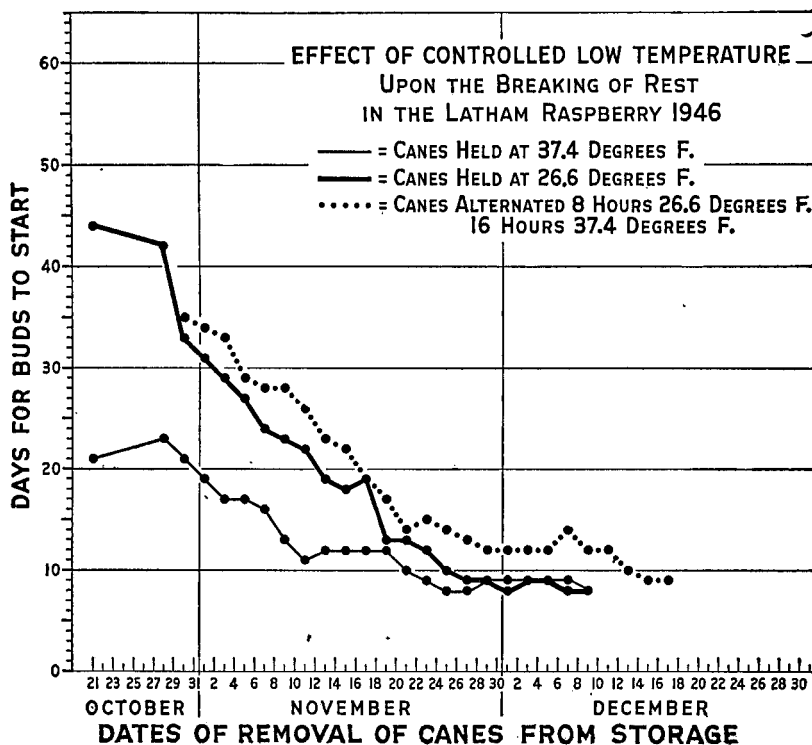


FIG. 1. Effects of controlled temperature on breaking the rest of Latham raspberries. 1946.

These results show that the effect of temperature below freezing was noticeable very soon after the canes had been exposed to these temperatures. In fact the initial effect of the below freezing temperatures seemed to be the most important in retarding the breaking of rest. On October 21, after the canes had been held in storage for a week the sample held at 26.6 degrees F required 23 days longer for growth to start than the sample held at 37.4 degrees F. On the other hand, on November 23, when rest was broken in the lot stored at 37.4 degrees F, there was only a difference of 3 days in the times required for growth to start in the two lots. Rest was broken in the lot stored at the lower temperature 4 days later. As the two curves tended to converge, it appeared that after the initial setback due to the low temperature, rest was broken at least as fast at below freezing temperatures. In other words, the effect of below freezing temperature on the canes stored at 26.6 degrees F was an initial check after which rest was broken as fast or faster than at higher temperatures. This initial effect of below freezing temperature tends to explain why canes exposed to alternating temperatures required more cold to break their rest.

The total number of hours of cold necessary to break the rest in the

Latham raspberry has been calculated from data recorded by Brierley and Landon (1) for the years 1943 to 1945 and by the author for 1946. It was found that an average of 1,405 hours at a temperature of 45 degrees F and below was required to break the rest. In the present experiment, however, in the lot held at 37.4 degrees F only 1,107 hours were required to break the rest, including hours of low temperature to which the canes were exposed in the field before they were collected. The lot held at 26.6 degrees F required 1,251 hours of cold to break the rest and the lot which received the alternating treatment required 1,470 hours. This latter figure is greater than the average required by canes whose rest was broken normally in the field but outside temperatures as a rule do not fluctuate as frequently above and below 32 degrees F as was the case in this treatment. Table I shows that rest

TABLE I—MEAN FIELD TEMPERATURES FROM THE DATE OF THE FIRST FROST TO THE DATE ON WHICH REST PERIOD OF LATHAM RASPBERRY WAS BROKEN AND TOTAL HOURS BELOW 46 DEGREES F REQUIRED TO BREAK REST

Year	Mean Temperature (Degrees F)	Total Hours
1943. ....	30.93	1,646
1944. ....	38.63	1,323
1945. ....	35.22	1,476
1946. ....	38.15	1,186

was broken more rapidly in seasons when the mean temperature was greater than in falls and early winters when it was less. When the mean temperature for the period from the time of the first frost until the date on which rest was considered to be broken was low, the number of hours at 45 degrees F or below required to break rest was great. Although there is not a direct relationship between this mean temperature and the number of hours required to break the rest, it lends support to the conclusion that temperatures between 45 and 32 degrees F do break rest faster than below freezing temperatures. The results agree with those of Chandler *et al* (2) who observed that rest was broken as rapidly at temperatures above 32 degrees F as at lower temperatures.

This experiment shows that rest is broken more rapidly by temperatures between 45 degrees and 32 degrees F than at sub-freezing temperatures. The retarding effect of sub-freezing temperatures appears to be due to an initial shock effect of such temperatures as continued exposure to sub-freezing temperatures breaks rest rapidly.

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