Table 3. Pheno-climatology for 'Elberta' peaches.[z]

Stage of development	Growing degree hr °C accumulation[y]	SD
First swell	2167	650
Calyx green	2617	533
Calyx red	3056	509
First pink	3717	674
First bloom	4239	658
Full bloom	5110	447
Post bloom	5972	559

[z]Based on climatological and phenological data for 'Elberta' peaches from Prosser, Washington for the years 1962-1964, 1965-1967; data supplied by E. L. Proebsting.
[y]Growing degree hour accumulation after completion of rest as determined from time of 790 chill unit accumulation (4).

completion. The difference in each case between the observed and calculated dates of full bloom was 2 days (Table 2).

Hourly temp for this and other field studies were estimated from the daily maximum and minimum values (6); GDH were calculated from these hourly estimates.

'Elberta' peach phenology. Nine years of phenological data for 'Elberta' peaches at the Prosser, Washington Experiment Station were obtained from E. L. Proebsting. Using climatological data from this station the accumulations of GDH's for each developmental stage were computed. Average values of these accumulations and their standard deviations are shown in Table 3.

A comparison of the data for 'Redhaven' peaches in Table 1 with those for 'Elberta' in Table 3, indicates that their recognizable stages of flower development correspond closely for any given energy accumulation.

1973-74 field tests. To further evaluate the model for both peach cultivars relative to field conditions in Utah, weekly phenological observations were taken during the Springs of 1973 and 1974 in 13 peach orchards along the Wasatch Front (Payson to Brigham City, Utah). Due to the severe cold weather in Dec. 1972 many trees were killed and those that survived had very few viable blossoms. Fortunately, seven orchards, that were fairly close to climatological stations in the U.S. Weather Service, contained sufficient blossoms to permit determination of most of the phenological dates. The same orchards were used in 1974. In almost every case the more recognizable stages of development occurred within a few days of the dates predicted by the model. The standard deviation of the difference between observed and calculated full bloom dates for these 2 years of data at the seven orchards was 3.3 days.

Conclusions. Field tests of the combined chill unit-growing degree hour model have proved its usefulness in predicting stages of phenological development.

The model permits an evaluation of the probable effects of various cultural practices in an orchard on tree development. It is also possible to predict the delay in bloom development that can be obtained by cooling the buds with overhead sprinklers. The model was used during the past 2 years in this manner and the predicted delay of the full bloom date was within 1 day of the observed date during both years.

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A Method for Selecting the Optimum Maturity Distribution for Mechanical Harvesting of Clingstone Peaches for Processing[1]

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Abstract. **High speed reflected light spectrophotometry was used to determine an optimum maturity distribution of mechanically harvested clingstone peaches (*Prunus persica* (L.) Batsch) for processing. Succinic acid-2,2-dimethylhydrazide (SADH) applied at pit-hardening, advanced the optimum harvest date from 3 to 5 days and increased the yield of processable fruit from 62% for the control trees to 80% for the treated trees.**

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Mechanical harvesting of clingstone peaches is a once-over operation which results in the harvest of a wide and continuously changing range of maturities. This often is the most serious problem in harvest mechanization (2). Sims et al. (7) reported on effects of SADH on color development (at a given firmness) for freestone fruit but did not consider its effect on the maturity distribution of clingstones.

The relationship between maturity distribution and optimum processing recovery can be critical: if too much fruit is immature, total recovery of processable fruit and processed quality will be reduced; if immature fruit are allowed to ripen, the quantity of over-ripe and tree-dropped fruit increases and total recovery decreases. The objective of this study was to develop a method for selecting the most advantageous time for once-over harvest by determining: 1) the maturity distribution of fruit on individual trees during the harvest period by use of a rapid sorting technique and 2) the effects of SADH on maturity distribution.

A block of 26 mature trees of 'Baby Gold 7' clingstone peaches, located in Greer, South Carolina, was used for this work. At the pit-hardening stage, half the trees were sprayed with 2000 ppm SADH at 15 liters/tree. The remainder served as border trees and controls. Two SADH treated and 2 control trees were harvested with the Clemson peach harvester (8) on each of 3 dates. Two control trees were also harvested at a later date. Fruit from each tree was kept separate for determination of maturity distribution. Following each harvest, the fruit was immediately loaded into an air-conditioned vehicle for transport to the laboratory. Time from detachment until measurement of maturity distribution was about 8 hr.

We used chlorophyll content as an index of maturity (5, 6), which we defined according to Gortner et al. (4) and implemented by automated color sorting, using reflected light (3).

At the laboratory we separated 30 fruits into 3 maturity categories by nondestructive measurement of chlorophyll with transmitted light using a "Neotec" color difference meter (1). This separation was based on the work of Sidwell et al. (6) relating optical density difference to chlorophyll content. The maturity categories were: ripe ($\triangle OD \leq 0.4$), midripe ($0.4 < \triangle OD \leq 0.8$) and immature ($\triangle OD > 0.8$) where $\triangle OD$ is the optical density at 730 nm minus the optical density at 700 nm. Fruit from these 3 categories were then used to calibrate an "FMC Spectrasort," which uses a reflected light principle and scans 80% of the surface area of each peach to classify it for maturity on the basis of the greenness of that surface area. This instrument was used to separate the remaining fruit at the rate of 6 to 8 fruit/sec into the 3 maturity categories noted. We used this procedure to obtain the maturity distribution for each tree.

The fruit from each of the maturity categories were processed as canned halves and evaluated for color grade using USDA color quality standards. For processed peaches, Grade B can be considered a break point for optimizing recovery. Five cans of fruit from each treatment (SADH sprayed and control trees) and harvest date were examined. A total of 909 processed halves from the ripe and midripe categories in the control fruit were graded and only 16 halves (2%) failed to equal or exceed Grade B color. Of 279 processed halves from the immature category, 158 (42%) failed to equal or exceed Grade B color. However, only 6 halves (1%) from a total of 872 SADH treated halves from all maturity categories failed to equal or exceed Grade B color standards. We therefore considered all raw fruit which were color sorted into the ripe and midripe categories by this procedure as processable fruit.

Total yield per tree ranged from 91 to 252 kg, with an average of 176 kg for the sprayed trees and 167 kg for the control trees. Low yielding trees were evenly distributed between treatments. A balance sheet showing the distribution of fruit in different maturity and loss categories is presented in Table 1. On the first harvest date, the total yield of fruit in the ripe and midripe categories averaged 44% for the SADH treated trees. There was a shift toward these maturity categories at the later harvest dates until the third harvest when fruit in the ripe and midripe categories averaged 80%. In the control trees there was a gradual shift toward these more mature categories which, however, reached an average of only 62% at the third harvest. At the fourth harvest for the control trees, fruit in the ripe and midripe categories averaged 62% with a loss of almost 35% to rot and drop.

Data from the ripe and midripe categories were combined for each individual tree and these totals were subjected to a second order polynomial regression analysis (Fig. 1). The maximum yield of processable fruit was attained August 7-9 for the SADH treated trees when 80% of the individual tree yield would have been expected to occur in the ripe and midripe categories. The expected maximum yield for the control trees was August 12 when 62% of the fruit would have been processable. We equate the period of maximum yield to the optimum harvest period.

Maturity distribution is a function of cultivar, climate, geographical location, and horticultural practices. The results of this work indicate that for any given population of peach trees, the maturity distribution for maximum recovery of processable fruit could be determined rapidly and objectively by sampling a few selected trees. Such a procedure could be invaluable for evaluating the effect of a horticultural practice or as a guideline for eventually establishing commercial harvest dates. Color development is much more uniform for the SADH treated fruit than for the controls and our observations suggest that no advantage is gained by color sorting SADH-treated 'Baby Gold 7' peaches.

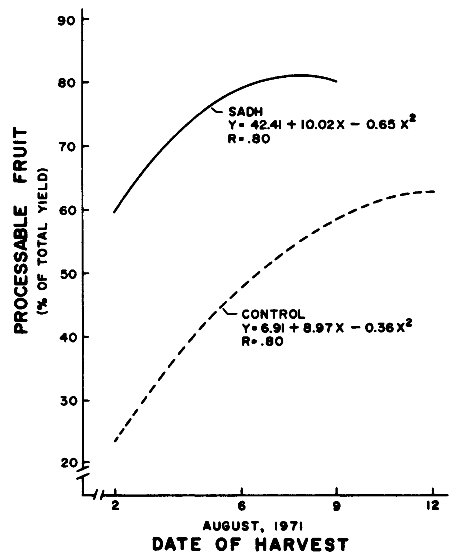

Fig. 1. Second order polynomial regression curves for processable fruit vs. harvest date.

Table 1. Recovery of mechanically harvested 'Baby Gold 7' peaches as % of total yield.[z]

Harvest date (August 1971)	SADH Maturity category Ripe	Mid-ripe	Im-mature	SADH Losses Rots	Drops	Control Maturity category Ripe	Mid-ripe	Im-mature	Control Losses Rots	Drops
2	38	14	33	8	2	8	8	73	7	1
	50	17	25	1	2	22	10	63	1	1
6	62	13	14	5	5	48	7	23	18	4
	72	12	2	3	6	9	26	57	1	4
9	79	–	–	9	12	50	6	31	7	4
	81	–	–	11	8	49	19	26	2	3
12	–	–	–	–	–	47	5	5	27	14
	–	–	–	–	–	71	–	–	13	15

[z]Total for row may not add to 100 because small diameter fruit dropped between belts of color sorter.

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