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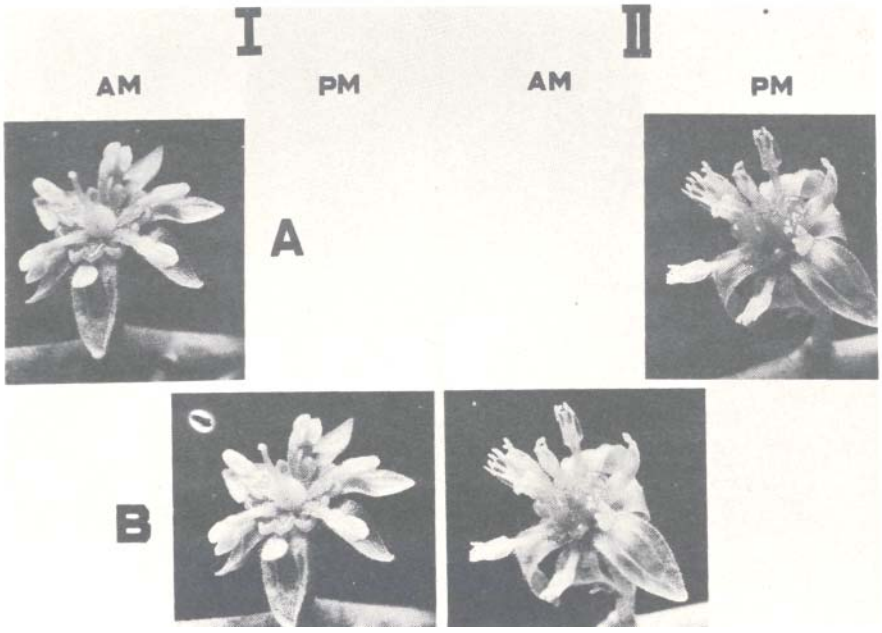
Flowering Types in the Avocado with Relation to Fruit Production

Peter A. Peterson
Formerly of University of California Citrus Experiment Station, Riverside, California. Now in Department of Genetics, Iowa State College, Ames, Iowa.

Previous studies (3, 5) have shown that an individual avocado flower has a dual opening cycle: stage I when it functions as a female (is receptive to pollination) and stage II, the male stage, when pollen is shed. In addition, avocado varieties fit into two general patterns of behavior (type-A and type-B) with respect to the timing of the dual opening flower cycle. In the avocado varieties of the A type, stage I occurs in the morning and stage II in the afternoon of the following day. In the B-type varieties, however, stage I occurs in the afternoon and stage II in the morning of the following day. Thus, the A-type cycle occurs over a 36 hour period and the duration of the B-type cycle is less than 20 hours. These patterns of flower opening behavior are illustrated in *fig. 1.*

FIGURE LEGENDS

1. Patterns of flower behavior in the avocado. Under glasshouse conditions, stage I in type-A varieties occurs in the morning, and stage II occurs in the afternoon of the following day. In type-B varieties, on the other hand, stage I occurs in the afternoon of the first day, and stage II in the morning of the following day.



The flowers of individual trees and those in avocado groves of any one variety all exhibit the same flower type and, in addition, the stages of the dual opening cycle are synchronous. The flowers of any one tree or those of different trees of the same variety open and close almost in unison.

It has previously been pointed out that stage I is the pollen receptive stage, when pollination and fertilization can take place. The flower then closes and when it 'reopens (stage II) pollen is shed. When the flower closes, following this stage II opening, the dual cycle has been completed. If pollination and fertilization have taken place, a fruit will develop. Otherwise, abscission occurs. In general, pollination during stage II is not significant in fruit production.

Could the unusual behavior of the avocado flower, with its dual opening cycle and two different timing schedules, be associated with the low production records of particular avocado varieties in specific areas? Why do some varieties consistently produce poorly in one area, while they are top producers in other areas? Does the flowering type (A or B) of a variety make it more suitable for a specific region?

It is known (2, 6 and Peterson in Press) that the avocado flower is sensitive to adverse weather conditions (low night and day temperatures) Flower development is delayed and this results in certain cases in the omission of the scheduled flower opening. At temperatures of 45° F or less at night, stage I flowers (female) of A-type varieties do not open in the morning, as expected, but are delayed until the afternoon. under the same conditions, stage I flowers of B-type varieties open very late in the day, or not at all, in which case these flowers may never be adequately pollinated by bees. (Bees become sluggish and inactive late in the day as temperatures drop.) Therefore, although A and B varieties are both affected by low temperatures, fruit set in the B types is more seriously jeopardized under such conditions.

In order to further solve some of these problems of low fruit production, the behavior of different avocado varieties in various areas of California was studied. It was possible to correlate the flower behavior with the productivity of the variety in each generalized and differentiated climatological area.

In Table 1, a number of prominent avocado varieties are listed. Each variety is classified according to its flowering type (A or B), and for most varieties the productive performance in 3 specific climatological areas is listed (1). These areas include a coastal, an intermediate and an inland region, such as would be found in Ventura County. C>I indicates that the performance of a particular variety is better on the coast than in an inland or intermediate area. I>C indicates that a variety has a better production record in the inland and/or intermediate area than in the coastal region. I=*C* indicates that the variety does equally well in both areas.

(The above data represent not only my own observations, but also those of individual growers, University of California Extension personnel and others, over a three year period. The author is especially grateful to Calvin C. Delphey, Ventura County Director of Agricultural Extension, and Robert Chapman of Calavo, for their appraisal of varietal production in Ventura County.)

Table I. Comparative productive capacity of the following avocado varieties in the 3 regions listed below.

Scale: 1 superior, 2 moderate, 3 inferior.

Variety	Flower Type	Coast	Intermediate	Inland	Correlation of productive performance along the coast (C) and in the intermediate and inland (I) areas. A-type Variety	B-type Variety
Anaheim	A	1	2	2	C>I	
Bacon	B	2	2	2		C=I
Benik	A*	1		1	C=I	
Carlsbad	A	1	2	3	C>I	
Clifton	B					
Collinson	A*					
Decem	A	3	1	2	I>C	
Dickinson	A*	1	2	3	C>I	
Duke	A	3	1	1	I>C	
Edranol	B	3	1	1		I>C
Elsie	B	2	1	2		I>C
Emerald	A	2	1	2	I>C	
Fuerte	B	3	2	2		I>C
Ganter	B*	3	2	1		I>C
Gehee	A					
Hass	A	1	1	1	C=I	
Irving	B	2	1	3		I>C
Jalna	A	1	1	1	C=I	
Linda	B*					
Lula	A*					
Lyon	B*					
MacArthur	A	1	1	1	C=I	
Mayapan	A*	1	1	3	C>I	
Mayo	A	1	1	2	C>I	
Mexicola	A	1	1	1	C=I	
Northrup	B	2	1	1		I>C
Nowels	A	3	1	3	I>C	
Puebla	A*	1	1	2	C>I	
Queen	B*	1	1	3		C=I
Regina	B	1	1	1		C=I
Rincon	A	1	1	2	C>I	
Ryan	B	3	2	2		I>C
Sharpless	A*	2	2	3	C>I	
Spinks	A*	3	1	3	I>C	
Topa Topa	A	2	1	1	I>C	
Wright	B					
Yama	A	3	2	1	I>C	
Zutano	B	1	1	1		C=I
Persea skutchii	B					
Persea borbonia	B					
Persea flocossa	A					

*Reference 6.

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Table II is a summary of the information presented in Table 1. Avocado growers have found that certain varieties yield more fruit in some areas than in other areas. The number of A-type varieties that produce better in a coastal habitat (C>I) than in an interior or interior or intermediate area is approximately equal to the number of A-type

varieties performing better in an interior location (I>C) than along the coast. However, with the B-type varieties, this is not true. No B-type variety produces better on the coast than in an interior or intermediate region (C>I=0). Three B-type varieties yield equally well in a coastal region and in an interior locality. Seven B-type varieties produce better in the interior than they do along the coast. Thus, in contrast to the A-type varieties, a proportionate amount of which do well in both the interior and coastal regions, no B-type variety performs better along the coast than in the interior

Table II. Summary of the productive performance of varieties of the different flowering types. C = coastal; I = intermediate or inland.
C>I indicates that the variety does better on the coast than in the interior.
C=I indicates that an equal number of varieties do well in each locality.

	C>I	I>C	C=I	Total
A	8	7	5	20
B	0	7	4	11

DISCUSSION

An equal number of A-type varieties do well along the coast and in the interior, whereas very few B-type varieties produce well along the coast. Is the B-type flower opening with the receptive stage in the afternoon more sensitive to cool coastal conditions than the A-type? What are the consequences of coastal conditions on B-type flower behavior?

It has previously been noted that avocado flowers react to unfavorably cool weather conditions by a delay in flower opening. Under these conditions, flowers of A-type varieties do not open until the afternoon, but the receptive stage still occurs during the warmer part of the day when insects are actively pollinating.

In contrast to the A-type varieties, the flowers of B-type varieties, under the influence of cool coastal temperatures, may open so late in the day that insects are no longer actively pollinating (4), or the flowers may not undergo a stage I opening at all. Under such circumstances, fruit setting is reduced and, in turn, production lowered. (If pollination does take place, the effect of cool coastal nights results in retarded pollen tube growth—another factor decreasing fruit setting.)

In the past, frequent reference has been made to the fact that certain varieties of avocados are more suitable than others to particular areas. This conclusion is usually based on such features as the frost resistance of the variety, sunburn susceptibility, drought resistance, etc. From the data presented here, it would seem reasonable to include the flowering type of the variety in any consideration of regional plantings.

SUMMARY

In summary, it has been observed that avocado trees of the B-type variety are, in general, less productive in the coastal areas. Our observations indicate that this lowered production of B-type varieties is associated with cool coastal conditions that, in turn limit the time and/or opportunity of B-type flower pollination and consequent fruit setting.

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