broader shoulders. The calyx end points are very pronounced and the color is bright yellow with pink to rose blushing on the exposed cheeks. Firmness exceeds either 'Red' or 'Golden Delicious' by two to four pounds throughout the harvest and storage seasons. It is this firmness and flavor that arouse the interest of Northwest fruit growers. The flavor is more aromatic than 'Red Delicious' and has a very sweet tartness to remind you of 'Golden Delicious'.

The tree growth characteristic is willowy resulting in excessive sun exposure to the fruit of young trees coming into bearing. It reminds us that evaluation of new varieties should not be hastily concluded before the tree settles into a mature status.

The high quality of 'Criterion' has stimulated many growers to plant commercial trials in Central Washington. The maturity date puts 'Criterion' in about the same season as 'Rome Beauty'. Early fruit from these trials is being channeled into market reception tests in California. The results of both storage ability and market acceptability has been very encouraging according to Everett Brandt, Carlton Nursery representative near Parker, Washington.

'Criterion's' patent was granted in 1974 and propagation rights were assigned to the Carlton Nursery Company, Dayton, Oregon.

Firmgold (Howell strain)

'Firmgold' was discovered in the Zeb Howell orchard near Zillah, Washington, in 1969. It grew as a chance seedling in an area surrounded by 'Red' and 'Golden Delicious'.

'Firmgold' is a very typey late 'Golden' with its five prominent points. One of its outstanding features in 1977 was the uniformity in type even with a low seed count. 'Red' and 'Golden Delicious' usually develop lopsided apples if the seed count is low. 'Firmgold' can develop a pink blush on exposed cheeks. Sunburn did *not* show when it occurred on other nearby varieties this year.

As near as we can determine, its harvest season is with 'Rome Beauty' or later by a day or two. As the name implies, the flesh is very firm when compared to 'Golden'. 'Firmgold' did not show any bitter pit in 1977 even though it appeared frequently in nearby spur 'Golden Delicious'.

The flavor and sweetness of 'Firmgold' is as good as 'Golden' if the apple is allowed to remain on the tree until the ground color breaks from green to yellow.

The patent for 'Firmgold' was granted in 1977 to Zeb Howell. The propagation rights are assigned to Callahan Nursery Sales of Yakima, Washington.

Breeding of Avocados in Australia

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There are now some 500 ha of avocados (*Persea americana* Mill.) in Australia chiefly of the varieties Fuerte and Hass. Less than 30% of the trees are of bearing age so it is evident that the industry is expanding but at the same time is rather restricted in its variety composition. The only variety developed in Australia which is grown commercially is Sharwil. This variety was produced by Mr. F. K. Sharpe of Queensland.

At present over 150 registered varieties of avocado exist throughout the

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world, the majority of which are chance seedlings or of unknown parentage (2). No variety of any importance has so far resulted from an avocado breeding programme and nothing is known of avocado genetics apart from a few character segregations described by Bergh and Storey in 1964 (1). This is partly because of the high rate of fruit abscission and the long generation time but another reason is that scientific breeding technique has not so far been applied to the avocado. Such an approach has been commenced at the Adelaide laboratory of the CSIRO Division of Horticultural Research in an attempt to breed avocado varieties suited to Australian conditions. Our breeding programme is based on the findings of research into the floral biology, pollination and fruit set of the avocado conducted at our laboratory.

Avocado flowers are functionally dichogamous and complementary flowering types occur to allow for cross-pollination (4). Hand pollination of the avocado is very efficient and a pollen tube reaches the ovary in a high proportion of the flowers pollinated (5). However, the efficiency is maintained only over a relatively narrow daytime temperature band centered around 25° C (6). Our breeding material is housed in a glasshouse so that the required temperature can be maintained irrespective of external weather conditions. The programme is based entirely on controlled hand pollinations so that the parentage of every fruit is known. Insects are excluded from the glasshouse so no chance pollinations can occur. Flowers are pollinated only on first opening in the female stage and a few flowers are pollinated per day during the flowering period. We have found that emasculation of the flowers is unnecessary. When the flower opens in the female stage the anthers have not yet dehisced and although pollen is often transferred from the anther to the stigma of the flower in the male stage, fruit set does not result (7). Bagging of the flowers is also unnecessary because the pollen does not become airborne but must be transferred mechanically from anther to stigma.

One disadvantage of the glasshouse environment is that relatively young trees provide the breeding material and these have a lower bearing capacity than older trees. However, they are more versatile than older trees. For example, budwood which has differentiated floral buds can be collected from field-grown trees before the late spring flush, stored up to 3 months at 4° C and bottle grafted when desired to established stock plants. Using this method flowers can be obtained outside the normal flowering period and synchronous flowering can be achieved in varieties which do not normally flower at the same time. Small trees can also be manipulated by transferring to a cooler environment to either slow down the development of initiated flower buds or to induce initiation on vegetative plants (3). Flower initiation can also be encouraged by cincturing.

In developing new varieties for Australian conditions, our particular interest is the semi-arid irrigated Murray River Valley area in S.E. Australia, Latitude 34, although we hope to assess material under a much wider range of climates, from the tropics of the north to the mediterranean climate of the south. We are particularly interested in early-maturing and late-maturing varieties to fill the gap at the beginning of the year when no avocados are available in Australia. We are also interested in material that will bear consistently as biennial bearing is a problem particularly in the Murray River Valley. Other requirements are good fruit quality, color, seed size, oil content and also a less vigorous habit than the existing varieties to facilitate harvesting. At present we are breeding solely for scion varie-

ties although in the future we hope to extend our interests to stock material also. In the latter case we would be looking for resistance to Phytophthora and to salinity, both of which are problems in different areas of Australia, and also for a dwarfing rootstock to give a more manageable tree.

Further research is under way to increase the efficiency of the breeding effort. The relative fruit setting and fruit carrying capacity of the available varieties must be investigated so that yields can be maximised by breeding only from the best varieties. Pollen storage also needs attention to enable the crossing of varieties which do not flower at the same time. Pollen/pistil compatibility is being monitored to ensure that the pollinations are resulting in fertilisation and fruit set and the possibility of embryo culture is also under investigation.

We believe that this is the first time that controlled scientific technique has been appied to avocado breeding and we hope to reveal some of the genetic diversity which must be present in a species which has received so little selection in the past. We also hope that by controlling parentage we will learn something of the genetics of the avocado, about which we know very little.

Literature Cited

1. Bergh, B. O. and Storey, W. B. 1964. Character segregations in avocado racial-hybrid progenies. *Calif Avo. Soc. Yrbk.* 1964, 61-70.
2. Brooks, R. M. and Olmo, H. P. 1972. Register of new fruit and nut varieties 2nd Ed. Univ. Calif. Press.
3. Buttrose, M. S. and Alexander, D. McE. 1978. Promotion of floral initiation in avocado by low temperature and short day length. Unpublished data.
4. Robinson, T. R. and Savage, E. M. 1926. Pollination of the avocado. *U.S.D.A. Circ. 387*, 1-16.
5. Sedgley, M. 1976. Control by the embryosac over pollen tube growth in the style of the avocado. New Phytol. *77*, 149-52.
6. _____. 1977a. The effect of temperature on floral behaviour, pollen tube growth and fruit set in the avocado. *J. Hort. Sci., 52*, 135-41.
7. _____. 1977b. Reduced pollen tube growth and the presence of callose in the pistil of the male floral stage of the avocado. *Scientia Hort. 7*, 27-36.

Blueberry Cultivars for Florida[1]

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Blueberries were first planted in commercial orchards in northwest Florida. Most of the plantings were made between 1890 and 1920 with rabbiteye blueberry bushes *(Vaccinium ashei)* dug from the wild. By 1920 blueberry plantations covered more than 2000 acres in North Florida (1). The rabbiteye blueberry is highly variable, and because bushes were often transplanted without selection for berry quality, fruits from resulting orchards were highly variable in size, color, and flavor.

The irregular quality of early Florida blueberries lowered their market appeal, and after improved cultivars began to be planted in the northern United States, the Florida blueberry industry declined rapidly, with most commercial acreage abandoned before 1940. Although the total acreage of commercial blueberries is presently quite small in Florida, improved cultivars are becoming available with which the industry could be revitalized.

Several factors should be considered in selecting blueberry cultivars for planting in Florida, either as dooryard

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