Apple and pear growing in Western Australia: a survey of trends in planting

Frank Melville
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Cover Page Footnote
The orchard survey was carried out by horticultural field officers who made personal visits to each orchard to obtain the statistics. These were prepared for collation by Head Office staff. Tabulation and collation of data was carried out by the Bureau of Census and Statistics who prepared summaries of the collected material. Further tabulations and calculations were made by the Department of Agriculture's biometrician. Grateful acknowledgment is made of the valuable assistance given by all those mentioned who made the preparation of this article possible.

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APPLE growing is the major fruit growing activity in Western Australia. The highest production recorded was 2,052,600 bushels in the peak year of 1960-61; of this 1,326,157 bushels were exported. Western Australia is second only to Tasmania in the quantity exported and at present relies on overseas markets to absorb about two-thirds of the crop. In 1962 there were 1,304,455 apple trees in this State and the average annual production over the previous five years was 1,449,962 bushels.*

The production area stretches from Perth, south to Manjimup and east to Mt. Barker and Albany. The main concentration is in the South-West, centred on Donnybrook, Bridgetown and Manjimup. There is also a considerable area of apples within a 30 mile radius of Mt. Barker and lesser areas in the Hills from Mundaring south to Dwellingup.

Pears are grown on a much smaller scale and are confined mainly to the Hills, Donnybrook and Bridgetown areas. The total number of trees recorded in 1962 was 92,010 with a five year average annual production of 145,739 bushels.*

Data on varieties and age of apple and pear trees is not available from statistical sources and a survey was carried out to obtain this information.

Department of Agriculture field officers completed the survey early in 1962 and the findings are set out in this report.

Figures obtained from the Departmental survey are lower than those published by the Government Statistician. Possible reasons for the variations are first, that Department of Agriculture officers made an actual count of trees instead of accepting the growers' estimates; second, that orchards outside the recognised commercial fruit districts were not included and, third, orchards which can no longer be considered commercial propositions were excluded.

The main purpose of the survey was to obtain information on the relative importance of varieties and age distribution and not to check on published figures.

The age groups recorded were 0 to 5 years, 6 to 10 years, 11 to 25 years and over 25 years.

Trends in varietal planting were determined by comparison with a previous survey conducted in 1946.

For the purpose of comparison the various apple and pear districts have been grouped into economic zones.

The Hills area includes the Shires of Mundaring, Swan, Darling Range, Armadale - Kelmscott, Serpentine - Jarrahdale and Murray.

Donnybrook includes the Shires of Donnybrook, Capel, Collie and Dardanup.

Bridgetown takes in the Shires of Bridgetown, Upper Blackwood, Greenbushes, Balingup, Nannup and Augusta-Margaret River.

Manjimup is confined to the one Shire.

Great Southern takes in Plantagenet, Cranbrook, Albany and Denmark.

* Figures published by the Commonwealth Bureau of Census and Statistics.

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Production figures for apples and pears in these zones compiled by the Bureau of Census and Statistics are shown in Table 1.

### TABLE 1
**AVERAGE ANNUAL PRODUCTION FOR THE 5 YEAR PERIOD 1957-58 TO 1961-62**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Five Year Average Production In Bushels</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apples</td>
<td>Pears</td>
</tr>
<tr>
<td>Hills</td>
<td>185,234</td>
<td>64,054</td>
</tr>
<tr>
<td>Donnybrook</td>
<td>306,175</td>
<td>21,513</td>
</tr>
<tr>
<td>Bridgetown</td>
<td>457,215</td>
<td>45,071</td>
</tr>
<tr>
<td>Manjimup</td>
<td>217,068</td>
<td>1,112</td>
</tr>
<tr>
<td>Great Southern</td>
<td>279,523</td>
<td>11,065</td>
</tr>
<tr>
<td>Total</td>
<td>1,445,205</td>
<td>143,415</td>
</tr>
</tbody>
</table>

Bridgetown has the highest production of apples but is second to the Hills in pear production.

### APPLES

Altogether 1,139,559 trees were recorded in the survey which is 116,253 more than in 1946, an increase of 11.3 per cent.

A comparison of plantings in the various zones is given in Fig. 1 which shows Bridgetown well ahead on total plantings, followed by Donnybrook, Great Southern, Manjimup and Hills in that order. In terms of old trees—over 25 years—the Great Southern zone displaces Donnybrook but otherwise the relationship is the same.

Although there has been a significant increase in apple plantings since 1946 undoubtedly the most important change has occurred in varietal relationships.

### Varieties

The Granny Smith now predominates in all districts and accounts for more than half of the total plantings. Cleopatra, Jonathan, Yates and Delicious are the other major varieties which together with Granny Smiths make up 92.6 per cent. of the total. Dunns, Golden Delicious, Dougherty and Rokewood account for another 5.9 per cent.

### TABLE 2
**COMPARISON OF APPLE VARIETIES RECORDED IN THE 1946 AND 1962 SURVEYS**

<table>
<thead>
<tr>
<th>Variety</th>
<th>1946</th>
<th></th>
<th>1962</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Trees</td>
<td>Per cent. of Total Plantings</td>
<td>No. of Trees</td>
<td>Per cent. of Total Plantings</td>
</tr>
<tr>
<td>Granny Smith</td>
<td>386,027</td>
<td>35.8</td>
<td>645,794</td>
<td>56.7</td>
</tr>
<tr>
<td>Cleopatra</td>
<td>122,321</td>
<td>10.8</td>
<td>144,437</td>
<td>12.0</td>
</tr>
<tr>
<td>Jonathan</td>
<td>145,315</td>
<td>12.8</td>
<td>132,520</td>
<td>11.4</td>
</tr>
<tr>
<td>Dunns</td>
<td>116,488</td>
<td>10.6</td>
<td>29,507</td>
<td>2.6</td>
</tr>
<tr>
<td>Yates</td>
<td>81,518</td>
<td>7.3</td>
<td>87,527</td>
<td>7.7</td>
</tr>
<tr>
<td>Rokewood</td>
<td>30,516</td>
<td>2.8</td>
<td>10,547</td>
<td>0.9</td>
</tr>
<tr>
<td>Delicious</td>
<td>27,458</td>
<td>2.5</td>
<td>45,792</td>
<td>4.0</td>
</tr>
<tr>
<td>Dougherty</td>
<td>18,975</td>
<td>1.7</td>
<td>12,984</td>
<td>1.1</td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>2,091</td>
<td>0.2</td>
<td>13,477</td>
<td>1.5</td>
</tr>
<tr>
<td>Democrat</td>
<td>8,611</td>
<td>0.8</td>
<td>4,011</td>
<td>0.4</td>
</tr>
<tr>
<td>Rome Beauty</td>
<td>8,339</td>
<td>0.8</td>
<td>1,454</td>
<td>0.1</td>
</tr>
<tr>
<td>Stakesman</td>
<td>6,372</td>
<td>0.6</td>
<td>2,680</td>
<td>0.2</td>
</tr>
<tr>
<td>Staymans Winesap</td>
<td>3,516</td>
<td>0.3</td>
<td>176</td>
<td>0.0</td>
</tr>
<tr>
<td>Nickajack</td>
<td>2,582</td>
<td>0.2</td>
<td>492</td>
<td>0.0</td>
</tr>
<tr>
<td>Sturmer</td>
<td>1,975</td>
<td>0.2</td>
<td>441</td>
<td>0.0</td>
</tr>
<tr>
<td>King David</td>
<td>978</td>
<td>0.1</td>
<td>58</td>
<td>0.0</td>
</tr>
<tr>
<td>Lalis</td>
<td>960</td>
<td>0.1</td>
<td>630</td>
<td>0.0</td>
</tr>
<tr>
<td>Willie Sharp</td>
<td>760</td>
<td>0.1</td>
<td>943</td>
<td>0.0</td>
</tr>
<tr>
<td>Lord Nelson</td>
<td>745</td>
<td>0.1</td>
<td>1,740</td>
<td>0.1</td>
</tr>
<tr>
<td>Williams Favourite</td>
<td>552</td>
<td>0.0</td>
<td>425</td>
<td>0.0</td>
</tr>
<tr>
<td>Gravenstein</td>
<td>514</td>
<td>0.0</td>
<td>458</td>
<td>0.0</td>
</tr>
</tbody>
</table>
The remaining 1.5 per cent. is made up of a large number of varieties of which only a few such as Williams Favourite, Lord Nelson and Gravenstein are still being planted.

An interesting comparison between varieties in the 1946 and 1962 surveys is given in Table 2 which also shows the percentage each variety bears to the total plantings.

The main point which emerges is the marked increase in the planting of Granny Smiths, amounting to 279,767 trees or 76 per cent. The percentage of Granny Smiths has risen from 35.8 per cent. in 1946 to 56.7 per cent. in 1962. Other varieties which show a significant increase are Delicious (66 per cent.) and Golden Delicious (64.4 per cent.). Small increases are shown for Yates, Lord Nelson and Williams Favourite.

The main reduction has been in Dunns (86,981 trees); only 2.6 per cent. of trees are now Dunns. Cleopatra has dropped by 48,884 trees, Rokewood by 19,640 and Jonathan by 13,295. Dougherty, Rome Beauty, Democrat and Statesman have also dropped back substantially and varieties such as Staymans Winesap, Nickajack and Sturmer no longer have commercial significance.

The Jonathan is the only variety which, while remaining a popular apple, has decreased in total plantings.

The changes which have occurred in the main commercial varieties in the past 16 years are illustrated graphically in Fig. 2. The dominant position of the Granny Smith is obvious.

Age of Trees

The future well-being of apple production is best measured by the age structure of plantings. The survey shows that the present position is a healthy one, as illustrated in Table 3.

<table>
<thead>
<tr>
<th>Age—Years</th>
<th>Number of Trees</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 and under</td>
<td>321,088</td>
<td>23.2</td>
</tr>
<tr>
<td>6-10</td>
<td>104,418</td>
<td>9.1</td>
</tr>
<tr>
<td>11-25</td>
<td>160,355</td>
<td>11.1</td>
</tr>
<tr>
<td>Over 25</td>
<td>553,695</td>
<td>42.6</td>
</tr>
<tr>
<td>Total</td>
<td>1,139,559</td>
<td>100</td>
</tr>
</tbody>
</table>

Fig. 2.—Showing varietal changes in apple plantings during the period 1946 to 1962.
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This means that 37.3 per cent. of all present apple trees have been planted in the past 10 years and 75 per cent. of these in the past five years. In 1946 about 13 per cent. of trees were under 10 years old. Considered from the point of view of varieties the picture is even more interesting, as shown in Table 4.

**TABLE 4**

**THE AGE DISTRIBUTION OF THE MAIN APPLE VARIETIES**

<table>
<thead>
<tr>
<th>Varieties</th>
<th>0-5 Years</th>
<th>5-10 Years</th>
<th>11-25 Years</th>
<th>Over 25 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granny Smith</td>
<td>33.7%</td>
<td>16.9%</td>
<td>38.0%</td>
<td></td>
</tr>
<tr>
<td>Cleopatra</td>
<td>9.6%</td>
<td>6.9%</td>
<td>58.8%</td>
<td></td>
</tr>
<tr>
<td>Jonathan</td>
<td>25.4%</td>
<td>9.0%</td>
<td>76.7%</td>
<td></td>
</tr>
<tr>
<td>Dunns</td>
<td>0.5%</td>
<td>5.1%</td>
<td>98.7%</td>
<td></td>
</tr>
<tr>
<td>Delicious</td>
<td>32.9%</td>
<td>22.9%</td>
<td>53.9%</td>
<td></td>
</tr>
<tr>
<td>Yates</td>
<td>34.7%</td>
<td>8.1%</td>
<td>51.1%</td>
<td></td>
</tr>
<tr>
<td>Dougherty</td>
<td>19.5%</td>
<td>11.5%</td>
<td>65.5%</td>
<td></td>
</tr>
<tr>
<td>Rokewood</td>
<td>0.2%</td>
<td>1.5%</td>
<td>96.2%</td>
<td></td>
</tr>
<tr>
<td>Golden Delicious</td>
<td>51.9%</td>
<td>28.5%</td>
<td>8.8%</td>
<td></td>
</tr>
</tbody>
</table>

The important feature is the emphasis on young plantings of Granny Smiths, Jonathan, Delicious, Yates and Golden Delicious. The Cleopatra, although still an important variety, consists mainly of old trees. Some plantings of Doughertys have been made in recent years but Dunns and Rokewoods are practically all more than 25 years old.

**THE GRANNY SMITH**

The Granny Smith is the dominant variety in all apple areas. This is illustrated in Table 5, which shows proportion of Granny Smiths planted in each of the main areas.

**TABLE 5**

**THE PROPORTION OF GRANNY SMITH TREES IN THE VARIOUS ZONES**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Number of Trees</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hills</td>
<td>72,777</td>
<td>59.8%</td>
</tr>
<tr>
<td>Donnybrook</td>
<td>191,746</td>
<td>75.4%</td>
</tr>
<tr>
<td>Bridgetown</td>
<td>206,585</td>
<td>59.4%</td>
</tr>
<tr>
<td>Manjimup</td>
<td>98,382</td>
<td>54.5%</td>
</tr>
<tr>
<td>Great Southern</td>
<td>82,984</td>
<td>41.2%</td>
</tr>
</tbody>
</table>

Fig. 3—Details of Granny Smith plantings by age groups in the various districts.
The big proportion of Granny Smiths at Donnybrook reflects the heavy planting programme in recent years, whereas new plantings in the Great Southern have been limited. A striking comparison is shown in Fig. 3 which also shows the age distribution of the trees.

Donnybrook shows the most spectacular change—43.2 per cent. of the trees are under five years old and 57.2 per cent. are less than 10 years old. Only 28.2 per cent. are over 25 years.

Bridgetown has also shown a marked increase in Granny Smiths—32.8 per cent. of trees are under five years and 42.8 per cent. less than 10 years. The total Granny Smith trees in the Bridgetown zone is shown slightly greater than Donnybrook but actually some of the Bridgetown orchards in the Balingup Shire are more closely linked to Donnybrook. However, whereas Bridgetown has 87,941 trees under 10 years, Donnybrook has 109,710.

Although overall plantings of Granny Smiths in the Hills area are little more than a third of Donnybrook plantings the rate of increase has been slightly greater; 47 per cent. are under five years and 61.4 per cent. are less than 10 years.

Changes in the other areas are much more moderate. At Manjimup 23.5 per cent. of trees are under five years and 38.7 per cent. less than 10 years. In the Great Southern area only 13.7 per cent. are under five years and 16 per cent. less than 10 years. This reflects the lack of new plantings in the Great Southern except in the last few years. It is interesting to note that the total number of Granny Smiths in both Manjimup and the Great Southern are only slightly greater than in the Hills.

**CLEOPATRA**

Bridgetown is the main home of the Cleopatra with 49 per cent. of all Cleopatra trees in the State. Fig. 4 shows that a large proportion of Cleopatras in all districts are over 25 years old. The only new plantings of any consequence are in the Bridgetown and Manjimup areas. Plantings of Cleopatras in the Hills and Donnybrook areas are very small.

**JONATHAN**

The Jonathan, although a popular local market apple, has failed to maintain headway. Plantings in 1962 were slightly less than in 1946 but Fig. 5 suggests there has been renewed interest in the variety in recent years.

In all districts new plantings have been made and 25.4 per cent. are now less than five years old, and 32.2 per cent. under 10 years. Apparently however, new plantings have barely kept pace with trees going out of commercial production. Bridgetown has the greatest area of Jonathans, followed closely by the Great Southern.
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<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>£157 10 0</td>
</tr>
</tbody>
</table>

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- Transcontinental HiFid., 2 Speaker, 4 Band

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Donnybrook has the smallest planting with Manjimup and the Hills on fairly equal terms only a little greater. The heaviest plantings in recent years have been made in the Hills where 59.6 per cent. are less than five years old.

**YATES**

Yates constitute only 7.7 per cent. of total apple plantings. However the interesting fact shown in Fig. 6 is that a large proportion is made up of young trees—34.7 per cent. are less than five years old.

On a district basis the relative position is given in Table 6.

---

**TABLE 6**

<table>
<thead>
<tr>
<th>District</th>
<th>Trees under 5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hills</td>
<td>8,799 (58.1%)</td>
</tr>
<tr>
<td>Donnybrook</td>
<td>5,918 (43.9%)</td>
</tr>
<tr>
<td>Bridgetown</td>
<td>9,768 (33.2%)</td>
</tr>
<tr>
<td>Manjimup</td>
<td>3,415 (32.4%)</td>
</tr>
<tr>
<td>Great Southern</td>
<td>2,450 (13.1%)</td>
</tr>
</tbody>
</table>

The number of trees in the six to 10 year old group is relatively small.

**GOLDEN DELICIOUS**

The Golden Delicious, although accounting for only 1.2 per cent. of apple plantings, is interesting because it is a young variety and because of the increased plantings which have been made in recent years. There are 6,989 trees or 51.9 per cent. under five years old and only 8.5 per cent. are over 25 years old.

**DELICIOUS**

The Delicious is a relatively minor variety in terms of plantings although it is popular on the local market. As with Yates new plantings have been made in all districts as indicated in Fig. 7. Of all Delicious, 32.8 per cent. are less than five years old and 43.9 per cent. are less than 10 years old. Only one third are over 25 years old. The new plantings are fairly evenly distributed among all districts except the Great Southern where the numbers are much less.

**OTHER VARIETIES**

Most other varieties consist of old trees gradually going out of commercial production. An exception is Williams Favourite which has been planted in small quantities over several years. There are 729 trees under 10 years old out of a total of 1,740 trees. Lord Nelson and Gravenstein are the only other accepted commercial varieties which have been planted but the numbers are very small. Several selected seedlings have also been planted commercially but their commercial value is still being assessed.

**FUTURE PRODUCTION TRENDS - APPLES**

The maximum annual production of apples is at present slightly over two million bushels. This crop is borne by about 750,000 bearing trees. A further 390,000 trees have not yet borne significant commercial crops and new plantings are still continuing. With changes in pruning methods and increasing irrigation in all areas these trees can be expected to yield much heavier crops when they come into full bearing than the trees at present bearing the main crop. The apple crop could possibly reach 3,000,000 bushels before 1970.
The main increase will be in Granny Smiths. At present the maximum crop is probably about 1,300,000 bushels, produced by about 390,000 trees. A further 255,000 trees are not yet in commercial production. It is quite possible that Granny Smith production could go as high as 2,250,000 bushels by 1970.

As far as other varieties are concerned, Cleopatras can be expected to further decline as older trees go out of production. Because nearly 60 per cent. of the Jonathan trees are old and declining this variety cannot be expected to increase appreciably in production until most of the young trees bear commercial crops.

Delicious is in a much healthier position with 44 per cent. of the trees under 10 years old and only one third over 25 years. With the proper use of chemical thinning sprays, Delicious crops could be more than doubled by 1970.

Yates also are in a favourable position. Over 40 per cent. of the trees are under 10 years old and although 51 per cent. are over 25 years old the rate of decline is slower for Yates. A substantial increase in total production can be expected before 1970.

Sixty-three per cent. of Golden Delicious trees are under 10 years old and only 8.5 per cent. are over 25 years. A rapid increase in production can be anticipated but as the total number of trees is only 13,500, production may not exceed 40,000 bushels in a heavy crop year before 1970.

It can be expected that the production of practically all other varieties will continue to drop.

PEARS

The distribution of pear plantings is different from apples but as the difference is one of degree rather than location the same economic zones are used for comparison. Pear growing is concentrated in the Hills and Bridgetown areas with smaller plantings at Donnybrook and in the Great Southern.

A total of 67,633 trees was recorded in the survey; this is 2.4 per cent. less than in 1946.

Figure 8 shows the relationship between plantings in the various areas—43.7 per cent. of the trees are in the Hills, 34.9 per cent. at Bridgetown and 13.8 per cent. at Donnybrook.

While the overall figures do not suggest major variations in pear plantings, a consideration of varieties will show that significant changes have taken place.

Varieties

The two main pear varieties are Bartlett and Packhams Triumph which together account for 75.7 per cent. of pear plantings. Other varieties of consequence are Josephine, Comice, Winter Nelis, Keiffer and Beurre Bosc which make up a further 22.7 per cent. These seven varieties constitute 98.4 per cent. of all pears in commercial orchards.

Considerable changes have taken place since the 1946 survey. These are shown in Table 7 and illustrated in Fig. 9.

Actually the total number of pear trees has fallen slightly over the 16 year period. This is due to a decline of 50 per cent. or more in all varieties except Bartletts and Packhams. Bartletts have increased by 38.8 per cent. but the popularity of Packhams is shown by the fact that they have gone up by 157.8 per cent. Bartletts are still...
slightly ahead in numbers, but Packhams are preferred in new plantings and are catching up.

Age of Trees

The age of mature pear trees is less important than with apples because pears live to a greater age. It is interesting however to consider the position of young trees Table 8 which give a lead to future production trends.

The distribution is similar to that for apples, with 35.8 per cent. of trees 10 years old or younger.

The position within the various varieties is shown in Table 9.

TABLE 8

AGE DISTRIBUTION FOR ALL VARIETIES

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Number of Trees</th>
<th>Per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 years and under</td>
<td>17,052</td>
<td>25.2</td>
</tr>
<tr>
<td>6-10 years</td>
<td>7,143</td>
<td>10.6</td>
</tr>
<tr>
<td>11-25 years</td>
<td>11,244</td>
<td>16.6</td>
</tr>
<tr>
<td>Over 25 years</td>
<td>32,194</td>
<td>47.6</td>
</tr>
<tr>
<td>Total</td>
<td>67,633</td>
<td>100</td>
</tr>
</tbody>
</table>

With the exception of a few Josephine and Comice all new plantings in the past 10 years have been Bartletts or Packhams. In the 0 to 10 year age group there are 9,918 Bartletts and 13,506 Packhams.

The Bartlett pear predominates in the Hills districts where there are twice as many trees as in all other districts. This position is also reflected in the young plantings indicating that the relationship is being maintained. Bridgetown and Donnybrook are the only southern districts with significant quantities of Bartletts.

The relative position in these districts is shown in Fig. 10.

PACKHAM'S TRIUMPH

Bridgetown is slightly ahead of the Hills in Packham plantings although the proportion of young trees is greater in the
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Hills. This suggests that the rate of planting in recent years has been in favour of the Hills. Donnybrook, the only other district with any number of Packhams, has less than half the number in either of the main districts. Figure 11 shows the relationship of plantings in these districts.

OTHER VARIETIES

The other varieties are distributed between Bridgetown, Donnybrook, the Great Southern and Hills with the greatest concentration at Bridgetown in each case.

FUTURE PRODUCTION TRENDS—PEARS

The maximum annual production of pears is now about 170,000 bushels. This can be expected to increase when the new plantings of Bartletts and Packhams come into production in the next few years.

The present Bartlett crop is being produced by about 18,000 trees. A further 8,000 trees have still to come into commercial production; these could increase production by 40 to 50 per cent. by 1970.

Packhams show even greater production potential. With the present crop borne by about 13,000 trees and a further 12,000 trees still to come into commercial bearing production could practically double by 1970.

Exact production figures are not available for pear varieties but it is thought to be about 75,000 bushels for Bartletts and 42,000 bushels for Packhams.

No increase in production can be foreseen for other pear varieties. If the trend
which has been apparent since the last survey continues, then production of these varieties can be expected to decline further.

![Fig. 10.—Showing the distribution of Bartlett pears by age groups in the various zones.](image1)

![Fig. 11.—Showing the distribution of Packham's Triumph pears by age groups in the various zones.](image2)

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**ACKNOWLEDGMENTS**

The orchard survey was carried out by horticultural field officers who made personal visits to each orchard to obtain the statistics. These were prepared for collation by Head Office staff. Tabulation and collation of data was carried out by the Bureau of Census and Statistics who prepared summaries of the collected material. Further tabulations and calculations were made by the Department of Agriculture's biometrician.

Grateful acknowledgment is made of the valuable assistance given by all those mentioned who made the preparation of this article possible.
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