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E. S. Haber

Iowa State College

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Effect of Harvesting, Spacing and Age of Plants on Yields of Asparagus

By E. S. Haber

AGRICULTURAL EXPERIMENT STATION
IOWA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS

R. E. Buchanan, Director

VEGETABLE CROPS SUBSECTION

AMES, IOWA
SUMMARY

1. Cutting asparagus until July 15 each year materially shortened the profitable life of the planting. The quality of spears as indicated by weight and diameter was so poor as to render the planting unprofitable after 5 years of harvesting to this date.

2. Cutting until July 1 was profitable for 6 years, but indications point to a reduction in weight and diameter of spear in the sixth year. The future trend appears to be downward.

3. Cutting until June 15 seemed to give the best results over the 6-year harvest period.

4. Cutting until May 1, May 15 or June 1 was not so profitable as cutting until June 15, although the market quality of spears was better in these three treatments than any of the others. The total yield was not sufficient, however, to justify discontinuing cutting at these dates. Continued records may show a different trend, however.

5. Plants spaced 1 foot apart in the row produce smaller spears than those spaced at 2 and 3 feet. Either 2- or 3-foot spacing is satisfactory as far as size of spear and total yield are concerned.

6. Rows spaced 5 feet apart produced more spears and more total weight than the lesser distances. The average weight of spear was superior at the 4-foot spacing and inferior at the 3-foot spacing.

7. Plants cut until June 15 the second year after planting produced smaller yields in subsequent years than plants which were not cut until the third season after planting.

8. Seed sown in the field where the plants are to grow permanently produced plants which were quite inferior to 1-year transplanted plants. Seed sown in pots and transplanted to the field produced plants inferior to 1-year-old plants.

9. A comparison of 1-, 2- and 3-year-old asparagus plants was made. The 3-year-old plants produced a poor stand and poor quality spears. There was little difference between the 1- and 2-year-old plants, although the 1-year plants were slightly better.
Effect of Harvesting, Spacing and Age of Plants on Yields of Asparagus

By E. S. Haber

ALTHOUGH Iowa has never ranked high among the states as a producer of asparagus for market or canning, the asparagus acreage planted, particularly by canners, is increasing.

No exact information is available concerning the effect of the cutting season’s length upon yields over a period of years. Market gardeners usually stop cutting asparagus in Iowa between June 1 and June 15. The demand for asparagus at this time decreases and the prices drop too low for profitable harvesting. To prevent damage to future yields, June 15 also appears to be the latest safe harvest date, though no substantiating experimental data have been available. Canners, however, could harvest asparagus later than June 15 profitably if such treatment did not injure the yield and quality of the future harvests.

The food supply manufactured in the asparagus plant by the green tops is translocated largely to the storage roots in the fall where it remains to be used in producing the succeeding year’s crop. If spears are cut to excess the period for manufacturing food is shortened, restricting the supply which should be stored for the production of the next crop and consequently reducing the yield and perhaps the quality of spears.

The yield and quality of spears also may be affected by the spacing between plants. The type of soil and fertility, of course, influence the planting distance, it being possible to plant closer on the heavier, more fertile soils than on the light sandy types which retain less moisture and are lower in fertility. The fertility can be governed, however, by the use of commercial fertilizers and manure.

The purpose of the investigation herein reported was to determine: (1) The effect of length of cutting season on yields and size of spears; and (2) the effect of various plant spacings on yields and size of asparagus spears. Other points, investigated on a smaller scale, were: (a) Age of plants; (b) the effect of cutting the second and third seasons after planting; and (3) sowing the seed in the permanent planting.

1 Project 295 of the Iowa Agricultural Experiment Station
EFFECT OF THE LENGTH OF THE CUTTING SEASON ON YIELDS

The author (1) published the results of the investigations on effect of cutting season’s length for the years 1929, 1930 and 1931 in a previous paper. At that time it was concluded "that plants cut until July 15, 1931, did not yield as much as plants cut to July 1, although seven more cuttings were made. In 1931 cutting until July 1 and June 15 greatly increased the crop produced as compared with plants cut until June 1. After harvesting plants to July 1 for 3 years no decrease in yield was noted, but the increase over the plants cut a shorter period of time, though significant, is not highly so, and future records may disclose that July 1 is entirely too late to harvest."

Since then data have been collected for the following 3 years, 1932, 1933 and 1934. Experiments conducted in Illinois and reported by Lewis (5) have shown that cutting the asparagus during the first year after planting was not profitable even if cut 2 weeks only. Cutting for 4 weeks the second year after planting reduced the yields, while cutting only 2 weeks apparently caused no decrease in yield. Severe cutting was injurious to both yield and market quality of spears, the injury increasing in proportion to the severity of cutting.

Jones (3) in California found that the average weight per spear was always heavier from plants cut only during the normal cutting season (May 15 to 20) than from plants cut about 2 weeks later than the normal season (May 31 to June 3).

To determine the effect of length of cutting season on yields, a series of plots was planted in 1927, using the Mary Washington variety. Plants were spaced 2 feet apart in rows 4 feet apart and 100 feet long. The soil was Webster silt loam. No fertilizers were applied at the beginning of the experiment, but in the spring of 1933, and again in 1934, 200 pounds of nitrate of soda, 400 pounds of superphosphate and 400 pounds of muriate of potash per acre were applied.

The first cuttings were made in 1929 and 6 years’ records are now available. Each year, rows were cut as follows: six rows were cut to May 1; eight rows to each of the following dates, May 15, June 1, June 15, July 1; and six rows to July 15. The rows to be cut were selected at random at the beginning of the experiment. Each series will be designated as a treatment.
hereafter, i.e., rows harvested until June 15 will be designated as the June 15 treatment.

To destroy weeds the entire asparagus planting was harrowed with a disc harrow each spring about the time the spears appeared at the surface of the soil. Shallow cultivation with a single-horse cultivator between the rows was used the rest of the harvest season and until the tops were too tall to permit cultivation without breaking. The tops were mowed and burned each fall after freezing weather had killed the stalks.

**EXPERIMENTAL RESULTS**

In fig. 1 the average number of spears per plot is presented graphically. Rows cut until May 1 produced about the same number of spears in 4 of the 6 years (fig. 1). Warmer weather in 1931 and 1934 accounted for the increase in number of spears. Rows cut until May 15 each year produced about the
same number of spears, except in 1934, when the number increased appreciably probably due to high temperatures. Harvesting until June 1, June 15 and July 1 caused an increase in number of spears over the preceding year in each of the three treatments except in 1933, when there was a slight decline in yield. When plants were harvested until July 15 each year, the total number of spears began to decline markedly in the fifth year (1933). As a result the plants were not harvested in 1934 since some had been killed by that time due to late harvesting.

Fig. 1 presents the average total weight, the numerals denoting the averages of the replicates. Maximum total weight for the sixth year was obtained from plants cut until June 15 each year. Asparagus harvested until July 1 in 1934 produced less total weight than rows cut until June 15, although the cutting season extended 2 weeks longer (eight more harvests) than with the June 15 treatments. The average weight per spear is a better index on which to base conclusions because the diameter of the spear definitely influences the market quality and price. According to Wellman and Braun (6), California asparagus, with very large or large spears, on the New York market brought higher prices than did medium or small spears.

The length of the spear influences the market quality, but all spears were cut when 6 to 8 inches high, and the weights of individual spears should give a direct comparison between treatments, although no actual diameter measurements were taken at time of harvest. Rows cut until May 15 produced larger spears than any other treatment at the end of 6 years. Rows cut until June 15 maintained about the same average over the 6-year period, and rows cut until July 1 produced smaller spears after 4 years (1932). Spears were smaller in 1933 and 1934. Cutting until July 15 caused a decline in average weight of spear the second year. The size, though small, remained about constant for 3 years, or until 1932, when a sharp decline in weight occurred. In 1934 the spears were so spindly that the rows were not harvested at all.

Mean differences to be significant in length of cutting season treatments are given in table 1.

On Sept. 10, 1934, after the stalks had attained full size in all treatments, their diameter was measured with a nursery tree
caliper graduated in sixteenths of an inch. Diameters of all the stalks from 10 plants in each treatment were recorded from 1 to 3 inches above the soil surface (table 2).

**TABLE 2. DIAMETER OF THE STALKS, SEPT. 15, 1934**

<table>
<thead>
<tr>
<th>Treatment of plots</th>
<th>Diameter of stalk in sixteenths of an inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>9.12</td>
</tr>
<tr>
<td>May 15</td>
<td>8.96</td>
</tr>
<tr>
<td>June 1</td>
<td>7.68</td>
</tr>
<tr>
<td>June 15</td>
<td>6.75</td>
</tr>
<tr>
<td>July 1</td>
<td>4.81</td>
</tr>
<tr>
<td>July 15*</td>
<td>4.56</td>
</tr>
</tbody>
</table>

*These rows were not cut in 1934 so stalks grew from early spring.

There is a steady decline from year to year in diameter of stalks produced by plants harvested the maximum length of time; stalks of plants cut the minimum length of time did not show this decline. Stalks of plants in the July 15 treatment were just one-half the diameter of the stalks of plants in the May 1 treatment. Differences in the average weight per spear between treatments must be greater than 0.106 to be significant. These results agree for the most part with the results secured when average weights of spears are compared.

It can be observed readily (fig. 2) that harvesting until July 15 is detrimental. In order to determine more accurately the effect of prolonged cutting, comparisons were made between three treatments, June 1, June 15 and July 1, by totaling to June 1 the results for each.
How many spears were cut by June 1 from the June 15 or July 1 treatments, though cutting continued after that date each year? The same question may be asked with regard to average weight per spear and total yield. To June 1 there is little difference in total number of spears between June 1 and June 15 treatments. The July 1 treatment produced fewer spears by June 1. When total weights are compared there is only a slight difference in favor of the June 1 treatment over the June 15 treatment. By the sixth year, however, the total yield of the July 1 treatment was much lower than either of the other two. In Fig. 2 the average weight per spear can be seen to be much smaller for the July 1 treatment and somewhat lower for the June 15 treatment.

**EFFECT OF SPACING**

It was thought advisable to determine the effect of spacing on yields and quality of spears, although spacings will vary with type of soil, fertility, etc. With closer spacing, will larger harvests be obtained in the early years and abandonment of the plantings be necessary after 6 or 8 years? Will the spear quality, as expressed by diameter, be affected by close spacing in such a way as to render the crop unprofitable? The experiment was planned to answer the above questions.
In 1928, 1-year-old asparagus plants were planted at the following distances: 3x1, 3x2, 3x3, 4x1, 4x2, 4x3, 5x1, 5x2, 5x3. The first number represents the distance between rows in feet and the second number the distance between plants in the row in feet. Four replications of each treatment were planted. At the same spacing a guard row, of which no harvest records were taken, was planted on either side of each treatment. The spears were harvested in the same manner as for the length of cutting treatments mentioned previously. Planted in 1928, harvesting was begun in the spring of 1930. Harvesting ended June 15 each year. The experimental results are presented for 1932, 1933 and 1934. Little or no plant differences between the various spacings were in evidence the first seasons, 1930 and 1931, so results are not given.

In all cases 1-foot spacings in the rows produced the greatest number of spears (fig. 3). In 1934, the greatest number of

Fig. 3. The effect of various spacing distances on number of spears, weight of spears and average weight per spear is presented. Plants planted in rows 5 feet apart, irrespective of the distance between plants in the row, produced in general the greatest number of spears in 1934 after 5 years of cutting. Plants planted 3x1 feet produced the smallest spears. Plants planted 4x2 feet produced spears equal to or better than any other spacings with respect to size of spear but produced fewer spears and less total weight than plants in rows spaced 5 feet apart.
spears was produced where plants were spaced 5x1 feet, then followed in order the 4x1, 5x2 and 5x3 spacings. Apparently the rows 5 feet in width are superior to 4- or 3-foot rows as far as total number of spears are concerned. When total yield, as measured by weight, is graphically presented (fig. 3), it is found that the 1-foot spacing of plants in the row is superior to the 2-foot, except in the case of the 5x1-foot spacing. The 5x3 plots produced slightly greater weight. On an average the 5-foot distance between rows is better than the 4- or 3-foot.

Plants spaced 2 or 3 feet in the row produce larger sized spears than those spaced 1 foot apart. This is shown in fig. 3, for 1934. The largest spears are produced at the 4x2-foot spacing and the smallest at 3x1.

The diameter of the stalks of the variously spaced plants was measured in 1934, the procedure being similar to that mentioned previously under “Effect of Length of Cutting Season.”

### TABLE 3. EFFECT OF SPACING ON DIAMETER OF STALKS.

<table>
<thead>
<tr>
<th>Planting distance</th>
<th>Diameter of stalk in sixteenths of an inch*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 x 1</td>
<td>4.73</td>
</tr>
<tr>
<td>3 x 2</td>
<td>5.35</td>
</tr>
<tr>
<td>3 x 3</td>
<td>5.49</td>
</tr>
<tr>
<td>4 x 1</td>
<td>4.77</td>
</tr>
<tr>
<td>4 x 2</td>
<td>5.03</td>
</tr>
<tr>
<td>4 x 3</td>
<td>5.97</td>
</tr>
<tr>
<td>5 x 1</td>
<td>5.15</td>
</tr>
<tr>
<td>5 x 2</td>
<td>5.30</td>
</tr>
<tr>
<td>5 x 3</td>
<td>6.15*</td>
</tr>
</tbody>
</table>

*To be significant, differences must be greater than 0.053.

The spacing 5x3 feet had stalks of the largest diameter in the fall, followed by the 4x3 and 4x2 spacings. Plants spaced 1 foot apart in the row produced the smallest diameter stalks. This is in accord with the results where the average weight of the spears is compared (fig. 3).

### TABLE 4. MEAN DIFFERENCES REQUIRED TO BE SIGNIFICANT IN THE SPACING PLOTS.

<table>
<thead>
<tr>
<th></th>
<th>Significant differences .05</th>
<th>Highly significant differences .01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of spears</td>
<td>122.73</td>
<td>163.50</td>
</tr>
<tr>
<td>Total weight per plot</td>
<td>94.95</td>
<td>126.47</td>
</tr>
<tr>
<td>Average weight per spear</td>
<td>0.049</td>
<td>0.065</td>
</tr>
</tbody>
</table>

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EFFECT OF CUTTING THE SECOND AND THIRD SEASON AFTER PLANTING

In 1931, 4 100-foot rows of 1-year-old plants were planted, spaced 4x2 feet. In 1932, two of these rows were harvested until June 15 and two rows were not harvested. In 1933 and 1934 the four rows were cut until June 15 each year. The data presented in table 5 show the effect of early harvesting.

<table>
<thead>
<tr>
<th>First cutting</th>
<th>1933</th>
<th>1934</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of spears</td>
<td>Total yield in ounces</td>
</tr>
<tr>
<td>Second season</td>
<td>855</td>
<td>550</td>
</tr>
<tr>
<td>Third season</td>
<td>925</td>
<td>583</td>
</tr>
</tbody>
</table>

Rows cut the second season produced fewer spears and less total weight of asparagus than the rows which were not harvested until the third season. The average weight of each spear showed no significant differences for the 2 treatments. These results are similar to those obtained by Lewis (5) in Illinois, though the plots at Ames were harvested for a longer period.

COMPARISON OF (a) 1-YEAR-OLD PLANTS, (b) SEED SOWN DIRECTLY IN THE PERMANENT PLANTING AND (c) PLANTS GROWN FROM SEED SOWN IN POTS.

In 1930 seeds were sown in 4 rows 50 feet long at 2-foot intervals in the row, i.e., 4 or 5 seeds were planted 1 inch below the surface of the soil, check-rowed 4x2 feet. After the seedlings were 1 to 2 inches high the hills were thinned to one plant. In January of the same year, seeds were sown in 21/2-inch pots in the greenhouse. Seedlings when about 1 to 2 inches high were thinned to one plant per pot. The plants were transplanted to the field on May 1, spacing them 4x2 in the same sized plots as above. The roots were not disturbed when shifted from the pots and were planted about 4 inches below the surface of the soil. The following spring (1931) 1-year-old
Plants were transplanted to the field, using the same spacing area as mentioned above. Harvesting was begun in 1933.

Plants grown from seed in a nursery row for 1 year and then transplanted to the permanent planting were superior to plants grown from seed sown directly in the permanent planting. Also pot-grown seedlings transplanted to the field after 5 months' growth in the greenhouse were inferior to 1-year nursery plants, but superior to plants grown from seed sown directly in the permanent planting. The spears from the latter and also most of the spears from the pot-grown plants were so small that they were not marketable.

### TABLE 6. NUMBER, YIELD AND WEIGHT OF SPEARS FROM 1931 PLANTINGS.

<table>
<thead>
<tr>
<th>1931 plantings</th>
<th>1933</th>
<th>1934</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of spears</td>
<td>Total yield in ounces</td>
</tr>
<tr>
<td>One-year-old plants</td>
<td>925</td>
<td>583</td>
</tr>
<tr>
<td>Pot-grown plants</td>
<td>1213</td>
<td>451</td>
</tr>
<tr>
<td>Seed planted in field</td>
<td>1181</td>
<td>184</td>
</tr>
</tbody>
</table>

### COMPARISON OF 1-, 2- AND 3-YEAR-OLD TRANSPLANTED PLANTS

In 1926, 1927 and 1928 asparagus seed was sown in nursery rows in the field. In 1929 plants from each planting were transplanted to the permanent location in rows 4 feet apart and 50 feet in length and the plants spaced 2 feet apart in the rows. Four replications of each year's plants were used. No cuttings were made until the third season, i.e., not until the spring of 1931. Records for the 1- and 2-year-old plants are presented only, since the stand obtained with 3-year-old plants was poor. It seemed to be impossible to secure a normal stand when 3-

### TABLE 7. MEAN DIFFERENCES REQUIRED TO BE SIGNIFICANT IN COMPARING 1 AND 2-YEAR OLD PLANTS.

<table>
<thead>
<tr>
<th></th>
<th>1-year average</th>
<th>5-year average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Significant</td>
<td>Highly significant</td>
</tr>
<tr>
<td>Number of spears per plot</td>
<td>128.9</td>
<td>0.049</td>
</tr>
<tr>
<td>Total weight per plot</td>
<td>82.2</td>
<td>0.088</td>
</tr>
<tr>
<td>Average weight of spear per plot</td>
<td>0.065</td>
<td>0.008</td>
</tr>
</tbody>
</table>
year-old plants were transplanted, due to the large size of crowns, causing enormous root loss when dug (fig. 4).

By 1934, after 5 years' harvesting records were available, there was not a significant difference in the yearly records between 1- and 2-year-old plants, though the 2-year plants produced a few more spears. The total weight per plot from the two treatments favored the 1-year-old plants by 1934, a difference approaching significance. When the average weights per spear of the two are compared, the 1-year plants produced slightly larger spears in 1934, though it is not a significant difference. When the 5-year records are combined and compared, however, it is found that the 1-year plants produce total yields greater than the 2-year plants that are highly significant and the average weight per spear of the 1-year plants is significantly greater than the 2-year plants. The difference in number of spears for the 5-year average is not significant.

**DISCUSSION**

In harvesting asparagus, an important problem to be considered is the length of cutting season which will give the most satisfactory yields over a period of years. The profitable life duration of an asparagus planting varies with soil, climatic conditions, cultural operations and the length of time of harvesting each year. At the end of the harvest season each year,
the green tops of the growing stalks manufacture the food supply. Most of this synthesized material is transported to the fleshy roots in the fall and is stored as a reserve to produce the crop for harvest the next year. Shortening the growing period by an extended harvest period will limit the amount of food which can be manufactured by the green tops. This in turn restricts the amount of food which may be stored in the roots in the fall, thus affecting the yield and quality of spears harvested the following year.

Harvesting until July 15 each year, for 5 years, was unsatisfactory. Each successive year showed a decline in total yield and in average weight of spear. By the sixth year the stand was so poor (plants were killed by severe cutting) and the spears were so small in diameter that harvesting was discontinued.

Over a 6-year period harvesting until July 1 each year had no apparent effect until the fifth year, when the average weight of spear became smaller and the total yield decreased in the sixth year of harvest. There was almost a steady increase in number of spears produced, reaching the maximum the sixth year. With a decrease in total weight for the sixth year and an increase in number of spears, naturally the size of spear became smaller and the market quality, as measured by diameter, was injured considerably. For the maximum profitable life of the plantation, harvesting to July 1 is impractical.

When spears were harvested to June 15 for 6 years, the quality as measured by average weight of spear, total yield and number of spears was not damaged. Apparently this date is satisfactory. From June 15 to the end of the growing season, i.e., until the stalks are killed by freezing weather, the tops have sufficient time to manufacture and store enough food material to produce spears of quality and quantity equal or better than the year previous. After the experiment has run for a longer period, however, it may be found that harvesting as late as June 15 may prove injurious.

The three treatments, May 1, May 15 and June 1, did not produce enough spears or weight to be as profitable as the June 15 cutting date. The average weight per spear was larger in these three treatments than in the June 15 treatment.

Plant spacing has a direct effect on the quality of spears.
Type of soil, fertility and cultural operations influence the spacing distance. Results obtained at Ames may not be applicable over the entire state due to the multiplicity of soil types. On sandy soils, wider spacings would be necessary, but probably there are no soils in the state where closer spacings as determined by these investigations could be recommended.

After 5 years of cutting, the 1934 results show that spacing plants 1 foot apart in the row causes a decrease in the average weight of spear. Although these differences are small as yet, subsequent harvest records may show a further decline. Jones (2) found the average weight per spear was significantly less at the 1-foot plantings than at the wider spacings.

Plants spaced 3 feet apart in the row did not show sufficient superiority over the 2-foot spacing to justify any conclusions. Since the 3-foot spacing was equal or superior to the 2-foot spacing, however, it might well be recommended.

A study as to the effect of distances between rows, in 1934, reveals that 3-foot rows are not to be recommended. The average weight of spear was reduced except in the 3x3 spacing to less than the average weight per spear of 4- or 5-foot row plants. The total yield at this distance was less in every case. The number of spears was reduced likewise except in the 3x1 planting, though the poorest quality spears were produced there. In general, 4-foot rows are slightly inferior to the 5-foot rows with respect to total yield and number of spears, but the 4-foot row spacing did not injure quality. The results in subsequent years may show a greater trend in favor of 5-foot row spacings.

When asparagus is planted in the spring, it has been conceded generally that the spears should not be cut the following season. This has been verified by Lewis (5) and Jones and Robbins (4). In this experiment spear cutting the second season after planting was extended to June 15. When cut to this date, yield, number and quality were less than that produced by plants when harvesting did not begin until the third season. Cutting to June 15 the second year may have been too long, since Lewis (5) found that a short season of harvest the second year after planting was not detrimental, while Jones and Robbins (4) showed that if the plants grew vigorously the first season they might be cut the second season for a short time without injury. In Iowa, where the growing season is shorter, some
injury might be expected. Certainly, a full season harvest to June 15 the second season is not to be recommended in Iowa.

It is well known that some plants are injured more by transplanting than are others. The immediate effect of transplanting is to slow down or stop growth of the plant for a period. Because of this, it was thought that sowing the seed where the plant was to grow in the permanent planting might result in faster growth of the seedling, making it possible to harvest earlier in the life of the plant. When non-transplanted plants or pot-grown plants are compared with 1-year-old plants transplanted, however, the results favor the latter markedly. Perhaps this is not a fair comparison, since the 1-year-old plants were transplanted 6 to 8 inches below the surface of the soil while the seed was sown at the depth of 1 inch. The tops of the crowns of the latter were never more than 1 inch below the surface, while the 1-year-old plants were deeper, so that cultural operations may have been far more injurious to the non-transplanted and pot-grown plants.

Nurserymen and seedsmen offer for sale 1-, 2- and, frequently, 3-year-old asparagus plants, but the stand obtained with the 3-year-old plants was so poor and the spears produced by them were of such poor quality that it would seem advisable not to use plants of that age or older. Comparison of 1- and 2-year plants favors the former slightly. Unless the price paid for 2-year-old plants was somewhat lower than 1-year-old plants, it would pay to buy the latter.

LITERATURE CITED