

**Senga Sengana** (Sieger x Markee) mid-season. Fruit: blunt conic, large to medium size, skin fairly dark red, flesh medium red, medium firm, juicy, good flavor. Easily capped — suitable for fresh fruit, freezing and processing. Plant: vigorous, productive, foliage resistant to leaf scorch, under certain growing conditions somewhat susceptible to leaf spot, fairly resistant to mildew, susceptible to fruit rot, suf-

fers from low-temperature injuries after hard winters lacking snow cover. Introduced in 1954 from Sengana GmbH, Hamburg (2).

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## Response of Peach Trees to Various Planting Distances<sup>1</sup>

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A fruit tree survey, published in 1976, revealed that 54 percent of the apple trees in Ohio orchards were on size-controlling rootstocks (4). This figure was up from 25 percent in 1968. Plantings on size-controlling rootstocks have facilitated closer planting distances and, therefore, more trees per acre. With the apple, such rootstocks usually result in flower-bud formation at an earlier age and increased yields per acre compared to trees on standard rootstocks.

Increasing interest continues to be shown relative to closer planting distances for peach trees than the conventional 20' x 20' used in the past. Before more progress in closer spacing of peach trees may be made, obtaining satisfactory dwarfing rootstocks or another acceptable commercial method must be found to reduce tree size and increase early yields. However, to date, a commercially accepted dwarfing rootstock for the peach is not available (5).

In recent years, a number of experimental and commercial peach plantings have been made in Ohio and other states where trees have been planted at closer spacings, both within and between the rows, than the traditional distances used in the past (2, 3, 6). Hayden and Emerson (2) were successful in confining peach trees to close spacings by summer pruning (hedging). This type of pruning requires special equipment and results in pruning wounds which may become entry canker sites. A trend of planting more trees per acre appears to be continuing with the peach and also other stone fruits as has occurred with the apple. The present study was undertaken to evaluate a system of dense planting coupled with early selective tree removal on peach orchard efficiency.

#### Materials and Methods

A peach planting consisting of 270 trees was established on a desirable site on the Jackson Branch of the Ohio

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Agricultural Research and Development Center near Jackson, Ohio, in April 1969. The cultivars Redhaven and Redskin were selected for this planting, with Halehaven as the guard or buffer trees. The planting distances utilized were 20 feet between rows and 20-, 15-, 10-, 7.5- and 5-foot spacings within rows. Plots were approximately 100' in length and those with the 20-foot spacing between trees contained 4 trees, while those with trees spaced 15, 10, 7.5 and 5 feet apart contained 6, 9, 13 and 19 trees per plot, respectively. Plots were separated in the row by appropriately spaced guard trees. Plots of each of the in-row planting distances were replicated 4 times except for the 10-foot spacing which had 8 replications. Alternate trees were removed after 6 growing seasons, in December 1974, in  $\frac{1}{2}$  of the plots with the 5- and 7.5-foot spacings, by cutting them off one foot above the ground. At the time of removal, weights of the trees were recorded.

All of the trees in the planting received an annual dormant pruning. In addition, beginning in the summer of 1974, the trees were also uniformly summer pruned to further control their height and spread. Summer pruning was especially essential due to loss of crops because of spring frosts and winter injury to flower buds with the subsequent excessive vegetative growth. The trees were headed at a

height of 12 feet and were approximately 4 foot narrower at the top than at the base of the canopy. Summer pruning was accomplished with tractor-mounted mechanical equipment — initially a slotting saw and later sheared with a cutterbar.

Nitrogen applications were made annually to crop load and tree requirements and based on units per plot rather than units per tree.

Data collected included yield, trunk circumference and pruning time. Some results have been published previously (1).

#### Presentation of Data

The first crop from this planting was produced in its third leaf in 1971. Due to low winter temperatures and spring frosts, satisfactory commercial crops were obtained only in 1971, 1975, 1978, 1979, and 1980 which was 5 of 10 years. Unfortunately, the loss of yield data due to crop failures, especially during the early productive years of the planting, has limited the information obtained from the planting. However, observations on tree growth and trunk circumference measurements have been useful in evaluating the effect of spacing on tree performance under irregular cropping conditions. Trunk circumference decreased as spacing between trees within the row was reduced (Table 1 & Fig. 1), indicating the increased

**Table 1. Trunk circumference of peach trees at several spacings within the row.**

Spacing (feet)	Circumference (cm)							
	1970	1971	1972	1975	1976	1978	1979	1980
20	13.7	23.4ab	32.6a	47.4a	51.2a	60.9a	63.1a	66.1a
15	14.9	24.9a	33.4a	47.8a	50.0a	57.3a	59.3a	62.0a
10	14.5	23.8ab	30.2b	42.7b	43.8b	50.0b	51.9b	54.1b
7.5	14.5	22.3bc	27.8c	38.3bc	39.5bc	43.7bc	45.2bc	47.1bc
5	13.8	20.7c	25.3c	34.7c	36.0c	40.1c	41.3c	43.0c

Duncan's New Multiple Range Test — .05 level.

**Table 2. Effect of alternate tree removal on trunk circumference.\***

Year	5 ft.	5 to 10 ft.	7.5 ft.	7.5 to 15 ft.
		(cm)		
1975	34.7	35.0	38.3	41.7
1977	37.9	41.2	41.7	47.9
1978	40.1	44.2	43.7	51.8
1979	41.3	46.1	45.2	54.6

\*Alternate trees removed in 1974.

competition which occurred between trees as the distance between them was reduced.

This competition is also evident from Table 2, which shows accelerated growth of remaining trees after alternates have been removed. Likewise, competition due to close spacing was also evident in the comparison of tree weights of the 5- and 7.5-foot spaced trees which were removed in 1974. Trees at 7.5-foot spacing averaged 102.6 pounds in overall top weight, while those at 5-foot spacing weighed 72.1 pounds.

Yield data (Table 3), for years when satisfactory commercial crops were obtained as well as those years when small crops occurred, reveals that 1971, 1978, 1979 and the cumulative yield (1971-80) had statistically significant higher yields in plots with 5-foot

spacing as compared to plots with the conventional 20-foot spacing. This was also the case during these years for the plots with 7.5- and 10-foot spacing vs. the 20-foot spacing with the exception of 1979. Moreover, although not statistically significant, a similar relation was evident in 1980. The 1975 data differed from the other years as the differences were not statistically significant. This may relate to the poor crop years of 1972, 1973 and 1974 when the trees made an exceptional amount of vegetative growth and trees in the closer spaced plots competed with each other to a great extent. It may also be seen (Table 4) that extremely small crops were produced in 1974 and 1977. From this yield data, it appears that one may expect yields per acre to increase as tree spacing is reduced from 20- to 5-foot intervals with the resulting increase in number of trees per given area.

In 1974, summer pruning was initiated to help to control tree height and spread. The greatest need existed with trees in the 5- and 7.5-foot spacings. These closer spaced trees were growing upward very vigorously due to crowding which was largely the result of very small to no crops the previous two years. As mentioned previously, the summer pruning consisted of heading back (hedging) to hold

**Table 3. Yield of peach trees at several spacings within the row.**

Spacing (feet)	Annual and cumulative yield (bu/A)							
	1971	1974	1975	1977	1978	1979	1980	Cumulative 1971-80
20	39d	11	458	9	238c	475b	258	1488c
15	85cd	57	564	9	384abc	595ab	251	1945abc
10	97bc	27	497	23	452a	610ab	325	2031ab
7.5	164a	24	484	42	551a	442ab	376	2083a
5	182a	45	499	18	435ab	716a	492	2387a
7.5-15*	—	—	293	24	238bc	459ab	217	1231bc
5-10*	—	—	371	14	382abc	614ab	350	1731abc

Duncan's New Multiple Range Test — .05 level.

\*Alternate trees removed in 1974 in 1/2 of the plots with 5- and 7.5-foot spacings.

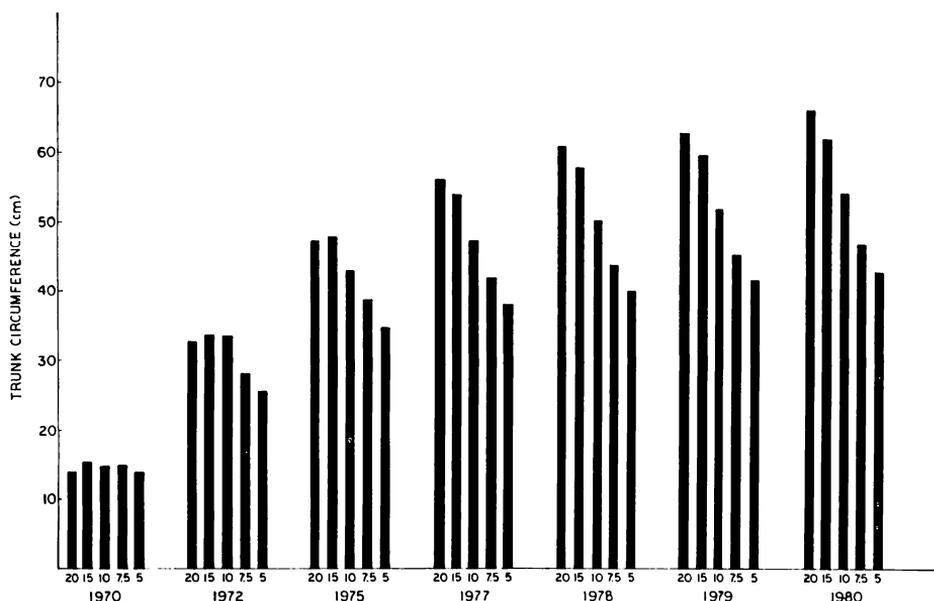


Fig. 1. Effect of tree spacing on trunk circumference.

height at 12 feet and reduce spread into aisles. Dormant pruning involved considerable thinning-out which is particularly important under irregular cropping conditions to result in as much efficiency as possible in the "on" years.

It is interesting to note the response of increase in yield per tree after alternate trees were removed in  $\frac{1}{2}$  of the plots of 5- and 7.5-foot spacings (Table 4). This difference is obvious in all but one of the six instances, namely in 1978 at the 7.5-foot spacing.

The plots with the closer tree spacings, which generally gave the higher yields, also required more pruning time. The time required for the dormant pruning, which was usually accomplished in late March, increased as the spacing between trees was re-

duced (Table 5). Time required for pruning the trees at the 5-foot spacing was 2 to 3 times that of the 20-foot spacing. This increased time for pruning was due to the greater number of

Table 4. Effect of alternate tree removal on tree yield.\*

Distance (ft)	1975	Year 1978 Lbs/tree	1979
20	202	105	209
15	187	127	197
10	109	100	135
7.5	80	91	73
7.5-15*	97	79	152
5	55	48	79
5-10*	82	84	135

\*Alternate trees removed in 1974.

Table 5. The influence of tree spacing on dormant pruning time.

Planting distance (ft.)	Dormant pruning time per plot (min.)								Cumulative 1973-1980
	Yr. 1973	1974	1975	1976	1977	1978	1979	1980	
20	105c	91b	59	52c	46	43b	70c	59c	525
15	163bc	113b	89	75bc	71	73b	121ab	80bc	786
10	204b	157a	86	78b	71	69b	119ab	103ab	887
7.5	319a	201a	118	70bc	54	60b	170a	130ab	1122
5	326a	180a	113	119a	91	121a	160a	160a	1270
7.5-15*	—	—	43	41c	60	59b	86bc	95abc	—
5-10*	—	—	60	56bc	54	70b	107abc	78bc	—

Duncan's New Multiple Range Test — .05 level.

\*Alternate trees removed in 1974 in ½ of the plots with 5- and 7.5-foot spacings.

trees per acre; namely, 109 trees per acre at the 20-foot spacing vs. 435 trees at the 5-foot spacing.

Whether or not the increased yields from the closer spaced trees outweigh the cost of the additional time required for pruning must be decided by each grower for his own situation. Considering prices, peaches in Ohio during the past 5 years have been in the 20 to 30 dollar per bushel range. If, for example, one takes the lower price of \$20 a bushel, the returns from the cumulative yield (1971-80) would range from \$29,760 per acre from the 20-foot spacing to \$47,740 per acre from the 5-foot spacing.

Considering the cumulative pruning time per acre from 1973-80, further calculations reveal that 236 hours were required to prune the 20-foot spaced trees vs. 487 hours for the 5-foot spacing. At \$3.50 for labor per hour, this equals \$826 vs. \$1,704, respectively. From this comparison and, in addition, considering the cost of the additional number of trees required to plant an acre at the closer spacing, the net return in dollars is considerably greater at the 5-foot spacing.

One concludes from the performance of this peach planting that increased yields per acre may be ex-

pected by planting peach trees closer within the row than the traditional distance of 20 feet used for many years. However, peach trees on seedling rootstocks planted as close as 5 or 7.5 feet apart will most likely require summer pruning in addition to dormant pruning to keep them within their allotted space. This is especially a necessity where crop loss may frequently occur due to low winter temperatures and/or spring frosts.

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