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Fruit Varieties Journal 42(2):65-67 1988

Effect of Training System on Precocity and Yield in 'Anjou' Pear[1]

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Abstract

Four training systems were evaluated for their ability to promote precocity in 'Anjou' pears. Both the angle-trained and spindle-trained trees produced significantly higher yields than central-leader trees with or without spreaders in the first 5 years of production after which production was similar in all 4 systems. Labour input during the tenure of the study was lower for angle- than for spindle-trained trees.

Predominant pear training systems are palmettes in Italy, flattened forms in France and spindle forms in Germany (4). The central leader system, which is common in British Columbia, is not noted for precocity and also requires several years to reach full production. A lack of capital return during this period and fluctuating fresh market prices have discouraged growers from establishing new pear orchards in British Columbia. This study evaluates the merits of 4 pear training systems to promote precocity in 'Anjou' pear. Labor input into each system was also considered.

Materials and Methods

One-year-old 'Anjou' pears on 'Bartlett' seedling rootstock were planted at 2.4 x 4.5 m in 1974. Each training system consisted of a single row of 30 trees separated by a buffer row of 'Bartlett' trees. All rows were orientated in a N-S direction. Vegetation in the tree rows was controlled with paraquat, and sod in the alleyways was mowed bi-weekly. Fertilizer (34-0-0) was applied at 225 kg ha^{-1} and urea sprays were used when leaf color dictated its need. Irrigation was provided by an overhead system. The 4 training systems were:

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i) Angle-trained trees were planted at 45° pointing to the north. The first strong upright shoot above the graft union was allowed to form a free-standing tree. Shoots from the original angled trunk above the most basal one grew sparsely but formed fruit buds within a year to two after planting. No pruning was done until the 8th year when the angled trunk, having served its purpose, was removed to leave an upright, well-spurred tree.
ii) Spindle-trained trees were headed at 75 cm in their first year. Limbs were selected along the axis of the leader on subsequent terminal growth and spread by means of ties attached to a rope collar at the base of the tree. Limbs were bent to a near-horizontal position. Ties were removed after fruit crop loads had established permanent positions in the limbs.
iii) Central-leader trees with spreaders were headed at 75 cm in their first year and 5 to 7 scaffold limbs were subsequently selected on subsequent terminal growth. These limbs were spread with nail-embedded wooden spreaders to 45°.
iv) Central-leader trees without spreaders were headed at 75 cm in their first year and 5-7 scaffold limbs were subsequently selected as above and trained by dormant pruning to outgrowing buds.

Fruit from each tree was harvested at commercial maturity and weighed. Data was analyzed as a completely randomized design with single trees as replicates but the limitations placed on the analysis by the experimental layout are fully recognized.

Results and Discussion

Total yield per tree in the first 5 years of production was higher in the angle and spindle systems than in the 2 central-leader systems but over the 8-year production period only the angle-trained trees were more productive than those in the 2 central-leader systems (Table 1). Spindle-trained trees were more productive than the central-leader trees without spreaders in the same 8 year period. Trees in the angle and spindle training systems had not outgrown their allocated space, but those in the cental leader training systems were beginning to crowd each other. Most of the fruit on the angle and spindle trees could be harvested from ground level but ladders were required after the 6th year of production in the central leader systems.

Other workers have noted higher yields from spindle-trained trees than from central-leader trees (1, 2) but production was either comparable (4) or lower (3) in angle-trained trees than in spindle-trained trees. The angle-trained trees in our system, although similar to the Bouché Thomas system (4) at the start, cannot be compared with others because they were allowed to develop into central-leader trees. However, the significant result from our angle planting was the early induction of precocity into the vertical shoot which became the central leader. Fruiting on the angled stem caused spurriness in the vertical shoot by the 2nd year of growth. As this vertical shoot became more dominant, vigor in the angled stem was reduced to such a degree that removal was deemed ad-

Table 1. Effect of training system on yield (kg/tree) of 'Anjou' Pear.

Year	Angle	Spindle	Central-leader with spreaders	Central-leader without spreaders
1977	2.0 a[z]	1.0 a	1.8 a	0.6 a
1978	28.9 a	22.0 a	8.9 b	5.5 b
1979	18.3 b	26.8 a	6.9 c	8.7 c
1980	39.5 a	39.9 a	26.6 b	13.4 c
1981	51.8 a	40.6 a	25.6 b	16.6 b
1982	66.2 ab	71.4 a	52.4 b	30.9 c
1983	101.7 a	92.8 a	87.9 a	105.5 a
1984	83.8 a	85.4 a	99.5 a	77.4 a
1977-1981	141 a	130 a	70 b	45 b
1977-1984	392 a	380 ab	310 bc	259 c

[z]Mean separation within each row by Duncan's multiple range test, 5% level.

visable. The early spurriness and fruiting of the vertical shoot suppressed its vigor and size control became quite evident when compared to the central-leader trained trees (visual observation). Virtually no tying down of branches was needed on the vertical shoot in our angle trees in the subsequent years of production. Pruning was minimal in the angle system during the first 5 years of production in direct contrast to the spindle-trained trees. Not only was labor input lower in the angle-trained trees than in the other 3 training systems (little pruning or tying was required) but a high yield was also achieved.

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Fruit Varieties Journal 42(2):67-72 1988

Yield and Fruit Quality of Apple Trees Under Three High Density Management Systems[1]

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Abstract

Comparisons were made in yield and fruit quality of apple (*Malus domestica* Borkh.) trees planted in 1979 and trained to the 3-wire trellis (1493 trees/ha), Lincoln canopy (1493 trees/ha) or Spindlebush (3986 trees/ha) systems. The cultivar and training system combinations included 'Golden Delicious,' 'Topred Delicious' and 'Starkrimson Delicious' trained to the 3-wire trellis, 'Golden Delicious' and 'Topred Delicious' trained to the Lincoln canopy, and 'Starkrimson Delicious' trained to the Spindlebush system. The cumulative yield of 'Golden Delicious' (from 1983 to 1986) was higher than 'Topred Delicious' and 'Starkrimson Delicious' on both the 3-wire trellis and Lincoln canopy. The cumulative yield of 'Topred Delicious' was comparable on the 3-wire trellis and the Lincoln canopy, but the annual production was more uniform in the latter. Individual tree yields of 'Starkrimson Delicious' were similar on the 3-wire trellis and Spindlebush, but the higher planting density of the latter resulted in significantly higher yield/ha. Fruit size and soluble solids in 'Topred Delicious' were higher on the 3-wire trellis than on the Lincoln canopy. The color and length/diameter ratio of 'Delicious' strains were not influenced by the training system.

Steadily increasing costs have created a need for increased production efficiency and higher production from each hectare of orchard. Grower response to these pressures has resulted in higher density plantings of fruit (4, 6, 9, 10). Apple trees in high density plantings are on dwarfing rootstocks which generally require support in the form of a trellis or a post. Various training systems for supported trees have been proposed and are being utilized in different parts of the world. Two commonly used systems of European origin include the vertical trellis and the Spindlebush (4, 6, 8). Recent trellising innovations in New Zealand have been directed not only towards the production of high quality fruit but also at mechanization of cultural operations (2, 3). The Lincoln canopy proposed for apples by Dunn and Stolp (3) radically alters tree shape and

[1]Received for publication . Approved for publication by the Director, West Virginia Agr. and For. Expt. Station as Scientific Article No. 2090.
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