Evolution of the Pear Training Model in South Africa

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Abstract
The history of pear pruning and training under the hot and dry conditions in South Africa is discussed. Due to the poor soils and the need for irrigation the move towards high-density plantings occurred with the continued use of the vigorous BP rootstocks. Planting densities have stabilized at ca. 4 x 1.5m (1667 trees/ha). Vigor in these plantings is managed through girdling and the manipulation of branching on young trees. These developments and technologies are discussed.

Keywords: Pyrus communis L., pruning

INTRODUCTION

The region (32° S) is characterized by a typical Mediterranean climate with mild, rainy winters and long, hot and often windy summers. Annual average rainfall varies from 250 to 1000 mm. The chilling in winter can vary from 250 to 1000 hours below 7,2°C. Nights in late summer and early autumn are often hot. This has adverse effects on the red colour development of bi-coloured pears (Steyn et al., 2004a and 2004b) and the progression of endodormancy in winter (Cook and Jacobs, 2000).

The parent rock from which our soils originate is of poor potential, resulting in soils that are limited and unbalanced with regard to macro- and microelements. Soils developing from the parent material generally have a low cation exchange capacity (1-6 meq/100g), and a low water holding capacity (50-230 mm/m). The pH of virgin soil is normally very low (pH (KCI) 4-5 range) and physical limitations are depth, wetness and compaction. These soils are variable over very short distances. Traditionally the best soils are reserved for apples and stone fruit while the remaining heavier, shallower, wetter soils are used for pears.

Prior to 1950

Orchards primarily consisted of widely spaced trees (6 x 6m and wider) on seedling rootstock. These trees were trained as large multi-leader trees that were either flood-irrigated or irrigated by movable sprinkler pipes. Soil preparation was done by hand and involved digging planting holes 1 x 1 m across and 0.6 m deep.

1950 to 1980

The closed vase training system or multiple leader tree (3 to 4 leaders per tree) gained popularity during this period (Strydom, 1985). 'Packham's Triumph' was heavily planted during this period and most new orchards were spaced at 5 x 3m.
The closed vase resulted in a pyramidal shaped tree with three to four main scaffolds on a common trunk. Whorls of fruiting branches (side scaffolds) were developed at intervals of 70 cm with the first whorl starting at 70 cm from ground level. Winter heading was used as a tool to stimulate the branches needed to develop side scaffolds at the given distances on the leaders. Heading in winter kept the trees vegetative, but was necessary to fill the rather wide spacing (5 x 3m) between trees in a meaningful way.

It was at this time that the clonal rootstocks BP1, BP2 and BP3 developed by our Department of Agriculture became popular. Pear trees on the BP rootstocks were only slightly smaller than on seedling rootstock but had all the other advantages of a clonal rootstock. Local soil scientists made significant contributions towards limiting problems of poor soils and limited water supply, especially with regard to soil preparation before planting, designing of permanent irrigation systems using drip or micro-sprinklers, and a scientific approach to nutrition.

Despite these advancements the Quince A rootstock which proved to be so successful for pears in many pear growing countries gave rather disappointing results in South Africa, especially with 'Packham's Triumph' - where it induces excessive russeting under the local conditions (Jacobs and Cook, 2003).

During this era horticulturists also became very aware of the negative effects of warm autumns and inadequate winter chilling on the growth and behaviour of deciduous fruit trees. Some of the more negative effects that collectively hinder orchard establishment and early bearing are the following:

- Many vegetative buds remain dormant after winter, resulting in excessively strong growth of the few shoots that do develop. These strong shoots tend to remain vegetative rather than becoming reproductive. Furthermore, these strong shoots develop autonomy within the tree structure, resulting in excessively strong basal branches. With poor chilling trees are much more basal dominant and less fruitful (Cook et al., 1995; Cook and Jacobs, 1999).
- The blossoming period is very protracted, often resulting in poor fruit set and variable fruit size.
- Fruit buds of high chilling varieties of pears may die when grown in areas characterized by mild winters.

A significant contribution during this era was the development of artificial rest breaking agents to alleviate the negative effects of inadequate winter chilling. At this time the quality of nursery trees was often poor, which increased the sensitivity of pears to transplant shock. This often resulted in poor growth in the first growing season, necessitating trunk renewal or the removal of all the side branches, combined with heading of the leader, in the first winter.

Trunk renewal implies a loss of a growing season. During this era much research was carried out to establish "rules" for maintenance pruning of pears and rules were developed for the handling of one-year-old shoots, two- and three-year-old fruiting units and spur systems. Collectively these rules resulted in a system of short pruning of pears (Saunders et al., 1991).

1980 to 1995

At the beginning of the eighties many semi-commercial experiments were established to evaluate the possibility of growing central leader pear trees at closer spacings, i.e., between 4.5 x 2.5 m and 4 x 1.5 m. The vigorous BPI and BP3 rootstocks were still the preferred planting choice. Pomologists realized that in order to be successful at the abovementioned spacings, much less heading during the vegetative phase should be employed in order to force the trees into early bearing.

Delayed heading was used to develop the basal scaffold branches only when necessary and only on the central leader. These side scaffolds were not headed, but notching, bud flicking, pinching, bending and girdling were extensively used to obtain trees with the required shape and complexity. This enhanced early fruiting significantly, despite the vigorous rootstocks. For more detail see Strydom (1998).

By now it was sometimes possible to obtain well feathered nursery trees, and in general the quality of "whip" trees was good. Trees were cold stored before planting and great care was taken to maximize the number of buds developing at the start of each growing season by the judicious use of artificial rest-breaking agents.
The characteristics of these central leaders trees were:

- A central leader was present with one set of side scaffolds located at a 70 to 110 cm height on the future trunk.
- The first set of side scaffolds consisted of four, but not more than six, members. Fruiting units were present on the side scaffolds.
- The members of the first set of side scaffolds adhered to the 3:1 ratio rule, i.e., the ratio between the diameter between central leader and side scaffolds should not be more than 3:1, although a 2:1 ratio was considered acceptable for pears.
- Above the first set of side scaffolds fruiting branches were present. The fruiting branches adhered to the 3: 1 rule and the branch angle was close to 70° off vertical. By keeping to the 3:1 ratio the fruiting branches became progressively weaker toward the terminal part of the central leader.
- Final tree height was considered a function of row direction. If the orientation is east-west, final height should not exceed 80% of row width. If the orientation is north-south, tree height could be 100% of row width.

1995 to the Present
During this period much progress was made using girdling to manage excess tree vigour in high-density plantings and today girdling is a standard practice in South African high-density pear orchards. With the availability of high quality nursery material (mostly strong whips), the management of "transplant shock" by artificially chilling the nursery trees in a cold room, and the optimisation of the planting conditions, it has become possible to completely avoid pruning at planting (Strydom, 1998). Developing pear plantings from "non-headed whips" is becoming common practice. After planting, branching is managed by scoring, notching and bud-flicking.

Without heading the resultant branches are "softer" and more fruitful. These branches are also increasingly trained to angles below 90°. This development was the result of success locally obtained in high-density apple plantings where the approach of the French researcher Jean-Marie Lespinase was followed. Another approach followed during this period was the removal of bottom scaffolds in 4 x 1 m and 4 x 1.5 m plantings that were established by heading at planting.

This era was also characterized by heavy plantings of bi-coloured pear cultivars, especially Forelle, Rosemarie and to a lesser extent Flamingo. Much thought went into the training of trees of these varieties to ensure maximum development of red colour. The growth habit of these varieties was manipulated, mainly through summer pruning, to resemble that of a spur-type apple tree. Another aspect that has become increasingly important in this period is the management of light in older orchards. Many pear orchards planted in the fifties and later show signs of poor light distribution, mainly due to the presence of too many heavy side scaffolds and too many "forks" in the upper part of the canopy.

The "forks" were the result of winter heading during training. It has become evident that these offending branches can be removed without reducing the crop. In fact, a steady increase in production has been observed following removal of "wrong" branches. This approach was also absolutely necessary in order to obtain acceptable packouts of bi-coloured varieties like 'Forelle' and 'Rosemarie'.

It has also recently became apparent that by employing the latest approach to soil preparation and by using the most recent developments regarding nutrition and irrigation (fertigation and open hydroponic systems) the South African fruit pear grower will in future be in a position to use the best quince rootstocks currently available.

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