Phenological Stages of Pears Grafted on Quince ‘CP’ Rootstock in Brazil

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Abstract
Despite of the increased consumption in the last years, pear production is still incipient in Brazil, supplying only 12% of the internal demand, mostly because the lack of crop technology, especially regarding to climatic adaptation in different regions. For this reason, a field experiment has been carried out since 2004, aiming to study the behavior of some pear cultivars grafted on quince ‘CP’ dwarfing rootstock, in Paraná State, southern Brazil. The pear trees were spaced 1.0×4.0 m and trained to a slender spindle. The trial was laid out using a randomized block design with five treatments, five replications and five-plant plots. In this paper the data are presented of phenological stages and their respective accumulated heat units (base temperature = 7.2°C) in the first crop. For ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’ pear trees the accumulated degree-days were respectively, from bud burst to full bloom: 96, 212, 466, 833 and 994, and from full bloom to harvest: 1109, 1525, 1271, 1472 and 1477. The number of days following full bloom (DFFB) were 102, 113, 93, 104 and 104; corresponding to the harvest dates of 16.12.2005, 21.01.2006, 21.01.2006, 02.03.2006 and 10.03.2006 for the ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’ pear trees, respectively.

INTRODUCTION
In Brazil, the yearly pear production is around 20,000 tons in 1,758 ha (FAOSTAT, 2005), while the import is almost three times this amount, principally coming from Argentina, Chile, the United States, Uruguay and Portugal (IBRAF, 2005). The expansion of this crop in Brazil has found difficulties, mostly due to the low technology and indefiniteness of cultivars and rootstocks adapted to different regions (Nakasu and Leite, 1990). The pear orchards are in its majority with cultivars of low quality such as ‘Smith’, ‘Garber’, ‘Kiefer’, ‘Laconte’ and others known as “Water Pears” (Faoro, 1999). However, the plant breeding programs of the Instituto Agronômico de Campinas (IAC) and Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) recently launched some cultivars with low chill requirements and reasonable fruit quality such as ‘Primorosa’, ‘Centenária’, ‘Seleta’, ‘Tenra’, ‘Triunfo’ and ‘Cascatense’ (Faoro, 1999).

According to Wertheim et al. (2001), world wide, new apple and pear orchards are planted more intensively than a few decades ago. Reasons for this trend toward high-density planting (HDP) are universal: earlier return on capital, economizing on labor input and producing a high yield of quality fruit. Until very recently, the only commercially viable dwarfing rootstocks for European pears (Pyrus communis) were clones of quince (Cydonia oblonga), such as ‘Quince C’, ‘Adams Quince’ and ‘BA29’. Nevertheless, none of these quince clones are as fully dwarfing as the apple rootstock M.9 and M.27 (Webster, 2001).

In Brazil, a quince dwarfing rootstock called ‘CP’ was launched by the Nursery Clone Propagação de Plantas that conferred an abundant bloom in the second growth cycle and about 40% growth reduction in ‘Hosui’ pears when compared to plants grafted on Pyrus calleryana (Botelho et al., 2005).

The purpose of this study was to verify the behavior of some pear cultivars grafted
on quince ‘CP’ dwarfing rootstock in Paraná State, Brazil, emphasizing the heat units accumulation and dates of the different phenological stages.

MATERIAL AND METHODS
The trial was carried out in an experimental orchard planted in September 2004 in Guarapuava, Paraná, Brazil (25°21'S; 51°30'W, 1,120 m a.s.l.), spaced 1.0×4.0 m and trained to a slender spindle. The experiment was laid out using a randomized block design with five treatments, five replications and five-plant plots. The following cultivars grafted on quince ‘CP’ dwarfing rootstock were evaluated: ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’. In this paper the data are presented from the first crop cycle, in 2005-2006. All plants were sprayed with 0.5% hydrogen cyanamide and 4% mineral oil in 23.08.2005 for budbreak.

In each plant, five branches were marked and weekly evaluated for percentage of sprouted buds and number of opened flowers. Full bloom was considered when 70% of the flowers had opened. The heat units were calculated or degrees-day by the daily mean method, in which a day is the time unit and each degree above a base temperature has an accumulative effect on fruit growth and maturity. The equation can be expressed as: daily heat unit = (maximum temperature + minimum temperature)/2 – base temperature. The base temperature used was 7.2°C (Varga and Chen, 1995). Harvest dates and accumulated heat units were registered for the different phenological stages.

Maximum and minimum daily temperatures were obtained from the Meteorological Station of Unicentro, placed about 50 m from the orchard.

RESULTS AND DISCUSSION
‘Cascatense’ pear trees showed the earliest and most uniform budbreak, attaining 100% of sprouted buds on 09.24.2005. ‘Tenra’ and ‘Hosui’ plants exhibited an intermediate behavior achieving about 70% bud sprouting on 11.12.2005. ‘Packham’s Triumph’ and ‘Williams’ pear trees had a poor, late and long period of bud burst achieving just about 40% of sprouted buds on 12.17.2005, demonstrating their low adaptation in Guarapuava, Brazil (Fig. 1). This region has a mean accumulation of 300 chilling hours in the winter (Botelho et al., 2006), while ‘Williams’ pears require between 1,000 and 1,200 hours of temperatures below 7.2°C (Ohlendorf, 1999).

The full bloom of ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’ pear trees were respectively on 09.15.2005, 09.30.2005, 10.20.2005, 11.18.2005 and 11.26.2005 (Fig. 2), and the accumulated degree-days from bud burst to full bloom were respectively: 96, 212, 466, 833 and 994 (Table 1).

For the ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’ pear trees the number of days following full bloom (DFFB) were 102, 113, 93, 104 and 104; corresponding to the harvest dates of 12.16.2005, 01.21.2006, 01.21.2006, 03.02.2006 and 03.10.2006 (Table 1). According to Varga and Chen (1995) the number of days following full bloom varied from 118 to 127 for ‘Williams’ pears in the Hood River Valley district, Oregon, USA. For Asian varieties Tvergyak (1985) reported periods between 112 and 150 days and Marini (2002) suggested the following intervals: ‘Bartlett’=100 to 115, ‘Bosc’ = 130 to 135 and ‘D’Anjou’ = 145 to 150, in Washington, USA. The shortest time verified in this research could probably be attributed to higher temperatures in Guarapuava, Brazil.

Heat units accumulated 6 to 9 weeks after bloom can help predict maturity and harvest date. This system is actually quite accurate for estimating maturity several months before harvest if the weather cooperates and if temperature can be accurately measured at specific fruit blocks (Tvergyak, 1985). For the pear cultivars ‘Cascatense’, ‘Tenra’, ‘Hosui’, ‘Packham’s Triumph’ and ‘Williams’ the accumulated degree-days from full bloom to harvest were 1109, 1525, 1271, 1472 and 1477, respectively (Table 1). Nonetheless, a sequence of many years is necessary for an accurate recommendation. The 50-year record (1944 to 1994) at the Mid-Columbia Agricultural Research and Extension Center has shown that correlation coefficients between the number of days from full
bloom (DFFB) and the accumulated heat units (AUH) are -0.9213 for ‘d’Anjou’ pears and -0.8300 for ‘Bartlett’ pears, respectively (Varga and Chen, 1995).

CONCLUSION

‘Cascatense’ pear trees showed the earliest sprouting, bloom and harvest and the lowest degree-days accumulation for fruit maturation. This could be commercially interesting once it is possible offer pears off season. Nevertheless, Guarapuava region usually has chilling periods (below 0°C) in the beginning of September which could be considered a damage risk. ‘Tenra’ and ‘Hosui’ pear trees featured the best adaptation achieving adequate sprouting and bloom. These two cultivars had a coincident anthesis, which could guarantee a satisfactory pollination. ‘Packham’s Triumph’ and ‘Williams’ showed limitations in this region where there is not enough chilling accumulation in the winter.

The rootstock quince ‘CP’ showed interesting characteristics such as earlier bloom and dwarfing effects on the canopies and could be a possible indication for pear orchards high density planting. This research will be carried out for eight more years and will bring important information for pear production in Brazil.

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Literature Cited


### Tables

Table 1. Dates, degree-days and number of days of some pear cultivars in Guarapuava-PR, Brazil.

<table>
<thead>
<tr>
<th>Cultivars</th>
<th>Full bloom</th>
<th>Harvest</th>
<th></th>
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<tr>
<td></td>
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<td>Degrees-day</td>
<td>Days</td>
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<td>Cascatense</td>
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<td>48</td>
<td>01.21.2006</td>
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<td>Packham’s</td>
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<td>77</td>
<td>03.02.2006</td>
<td>1472.0</td>
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<tr>
<td>Williams</td>
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<td>944.4</td>
<td>85</td>
<td>03.10.2006</td>
<td>1477.1</td>
</tr>
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</table>

1 From bud burst to full bloom.

2 From full bloom to harvest.

### Figures

![Graph showing sprouting percentage of pear cultivars](image)

**Fig. 1.** Sprouting percentage of some pear cultivars grafted on quince ‘CP’ rootstock in Guarapuava-PR, Brazil. Vertical bars are the SD (n = 5).
Fig. 2. Anthesis percentage of some pear cultivars grafted on quince ‘CP’ rootstock in Guarapuava-PR, Brazil. Vertical bars are the SD (n = 5).