High-density training systems

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Cherry COST Action FA 1104
Training school « Rootstocks and training systems »

Which system to choose ?

- ***Technical and financial risks***
  - *Size of investment*
  - *New techniques*
- ***Reliable high quality cherry production***
  - *Cracking*
  - *Pests* (Rhagoletis cerasi, Drosophila suzukii, wasps…)
  - *Marks due to wind*
  - *Hail*
- ***Reducing harvest and pruning labor***
  - *Limit the development of the trees (height, width)*
  - *Partial or total mechanical pruning (thinning)*
- ***Reducing chemical imputs***
- ***Choosing varieties and rootstocks***
  - *New varieties available*
  - *New roostocks available*
- ***No universal training system***

Training systems

- **Fruiting wall**
- **Axis**
- **Biaxis, triaxis, palmette**
- **U.F.O**.

All these training systems require trellising (3 to 5 wires)

Fruiting wall

- *The cherry fruiting wall is based on the apple orchard management concept developed by two colleagues of mine, A. Masseron & L Roche*

Objectives

- Reducing labor by mechanising pruning and making the harvest easier
- Easy to protect from rainfall and pests

First trial in 2001

- *8 varieties with very different growth habit and productifivty*
  - *Ferdouce, Ferrovia, Kordia, Regina, Fertard, …*
- *Rootstock : Tabel® Edabriz (dwarfing)*
- *Shape of the trees : axis*
- *Distances between trees : 1,5 m*
- *Height of the wall : 2,2 m*

Fruiting wall

- ***Mechanical shoot tipping***
  - *First mechanical shoot tipping in the3rd year*
  - *Tipping when the new shoots have 12 leaves*
    - *All the lateral branches were keep including those perpendicular to the row*
    - *40-50 cm from the trunk on both sides of the row*
    - *2.2 m from the ground*

Lessons learned from this first trial

- *Remove the lateral branches perpendicular to the row*
  - *Shade and difficulties to replace the fruiting branches*
- *Hand prune the branches never prune by the machine (parallel to the row)*
- *Choice the varieties and roostocks depends on soil, area, shape of the tree : productive to very productive one*
- *Adapt time of mechanical pruning depend on annual growth*

Fruiting wall

Regina/Tabel ; 1.50 m between the trees, 2.2 m height, harvest without ladder

Fruiting wall

Trials in progress

1- Plantation 2005 at La Tapy

- Variety : Folfer
- Rootstocks : Tabel® and Maxma 14
- Shape : axis
- Spacing (Tabel® ; Maxma 14)
  - Between the trees : 1.25 m ; 1.5 m
  - Between the rows : 3.0 m ; 3.5
  - Density (trees/ha) : 2667 ; 1905
  - Height of the wall : 2.8 m ; 3.3 m
  - Time of mechanical pruning : up to 10th leave : in may
  - Soil : fertile
- Vegetative growth
  - Tabel® : good up to 10th leaf, too low now
    - Mechanical pruning : if necessary at the end of winter, never happen during growth
  - Maxma 14 : too vigorous
    - Scoring on the trunks
    - Lower irrigation
    - Nitrogen : none as long as necessary

Fruiting wall

Trials in progress

2 - Plantation 2009 at Ctifl

- *Varieties : Bellise® Bedel, Folfer*
- *Rootstock : Gisela 6*
- *Shape : Bi & triaxis*
- *Spacing*
    - *Between the trees : 2.5 m*
    - *Between the rows : 3.5 m*
    - *Density : 1142 trees/ha*
    - *Height of the wall : 2.70 m*
    - *Time of mechanical pruning : end of winter*
    - *Soil very poor, so medium to poor vegetative growth*

Fruiting wall

Trials in progress

3 - Plantation 2012 at La Tapy

- *Varieties : Regina*
- *Rootstock : Gisela 6*
- *Shape : Biaxis*
- *Spacing*
    - *Betweetn the trees : 1.5 m*
    - *Between the rows : 4 m*
    - *Density : 1666 trees/ha*
    - *Height of the wall : 3.0 m*
    - *Time of mechanical pruning : end of winter*
    - *Soil : fertile, good vegetative growth*

Fruiting wall

Trials in progress

4 - Plantation 2012 at Ctifl

- *Varieties : Bellise® Bedel, Folfer*
- *Rootstocks : Gisela 6 & Weiroot 158*
- *Spacing*
    - *Between the trees :*
        - *Weiroot 158 : 2.0 m*
        - *Gisela 6 : 2.5 m*
    - *Between the rows : 3.7 m*
    - *Density : 1081 (Gi 6) & 1351 (W 158) trees/ha*
- *Height of the wall : 3,0 m*
- *Time of mechanical pruning :*
    - *Up to now : end of winter*
    - *Following years : may be during vegetative growth*

If the growth becomes too strong

Fruiting wall

Coup'éco machine

Bellise® Bedel/ Gisela 6, 5th leaf

Results

- ***Yield***
  - *2nd leave : first fruit*
  - *3rd leave :1 t/ha*
  - *4th leave : 6 t/ha*
  - *5th leave : 10 t/ha*
  - *6th and following years (expected results) : full production, 15 t/ ha or more depend on varieties, roostocks and height of the wall*
- ***Size of the fruit***
  - *80% to 90% > 26 mm, depend on the variety*

Fruiting wall

Objectives

- Reducing labor by mechanising pruning and making the harvest easier
- Easy to protect from rainfall and pests

Shape of the trees

- Axis, biaxis, palmette

Pruning

- Mechanical pruning after the 3rd leaf
  - Always at 40-50 cm from the trunk
  - Time of mechanical pruning depends on the vigor and growth of the trees
  - Length of time : 6 to 8 h/ha/year
- Additionnal winter pruning
  - Allow the light to penetrate the wall
  - Renew the fruiting branches
  - Length of time : 20 à 50 h/ha/year

Fruiting wall

Important factors

Choice of varieties

- Varieties, regularly productive & very productive
- **Good results with**
  - Bellise® (maturity 4-6 days after Burlat)
  - Ferdouce (maturity 10 days after Burlat)
  - Folfer (maturity 8-10 days after Burlat) depend on the area (chilling requirement)
  - Rubin (maturity 27-30 days after Burlat)
  - Regina well-pollinated (maturity 28-32 days after Burlat)
- **Medium results with**
  - Kordia
  - Ferrovia
- **Bad results** with varieties with medium productivity or no regular yield
  - Since 2007, on the plains in the South-East of France we have to pay attention to the chilling requirement

Fruiting wall

Choice of the rootstocks

- *Productive and very productive*
- *Dependant on*
  - *Soil fertililty*
  - *Vigor of the variety*
  - *Shape of the trees : axis, biaxis, palmette*
  - *Currently - best results with*
    - *Tabel® Edabriz on very fertile soils*
    - *Gisela 6, Weiroot 158 on fertile soils*
    - *Maxma 14 on medium soils*
  - *Other rootstocks (not yet tested with fruiting wall)*
    - *Gisela 5 on very fertile soils and in northern areas*
    - *Piku 1 on fertile soils*
    - *PHL-A on medium soils*
    - *Gisela 12*

Fruiting wall

Mechanical pruning & annual growth

- ***If adequate or too much*** *: mechanical pruning during growth before harvest*

- ***If insufficient*** *: mechanical pruning at the end of winter*

Axis, biaxis, palmette

- *The choice between these different systems will depend on the expected development of the soil/cultivar/rootstock combination. The greater the vigor, the more axes are needed to divide the growth and limit the development of the trees as far as height and width are concerned.*

- Earlier full bearing
- Reduce labor time
- New varieties available
- New rootstocks available
- Protect the trees from rain and insects

Axis

Axis is not a new training system <u>but over the last 7 years we have significantly reduced the width of the trees.</u>

Rootstocks

- ***<u>Only dwarfing rootstocks</u>***
  - ***Gisela 3*** *(very good soils in northern areas -Belgium, Germany, west of France - not effective in South-East of France)*
  - ***Gisela 5*** *(good soils in northern areas - Belgium, Germany, west of France - not effective in South East of France)*
  - ***Tabel® Edabriz*** *: very good soils, be careful of aphid attacks*
  - ***Piku 1*** *: it seems to be a good rootstock for numerous kind of soils and areas*

Axis

Appropriate varieties

- ***Growth habit***
  - *semi-spreading, spreading, willowy*
  - *Avoid upright habit (Burlat, Rainier, Lapins)*
- **Ramification**
  - Intensity : good
  - Crotch angle : wide

- ***Axis** : select varieties with spreading habit with a good ramification and wide crotch angle (Regina, Rubin, Ferdiva, Ferdouce), avoid varieties with upright growth and poor ramification (Summit, Satin®, Rainier, Lapins, …) to improve the ramification it may be possible to spray plant growth regulator like promalin (if this product is authorized).*

Axis

- *No pruning at plantation*
- *First year*
  - *Promote the growth of the axis*
    - *During vegetative growth, remove the new branches regularly*
  - *Scoring*
    - *In January or February impose bud activation to stimulate lateral shoot formation by scoring the well-positionned buds (avoid those which are perpendicular to the row).*
- *Second year*
  - *Promote the growth of the axis*
    - *Remove all the branches 15 cm below the axis*
    - *Remove the branches perpendicular to the row*
    - *One branch every 20 cm*
    - *If necessary (it depends on the varieties) promote wide branch angles by spreading or tieing down.*
  - *Scoring*
    - *In January or in February, carry out the same scoring as the previous year on the new portion of the leader*

Axis

- *Third year*
  - *Same pruning as in 2nd year*
  - *Beginning of bearing on axis spurs and at the base of previous season shoots (2 to 4 t/ha)*
- *Forth year*
  - *The yield starts to reach a good level (10 to 15 t/ha)*
  - *Head back the leader to a weak lateral shoot at the height you want to stop the growth (if the trees are protected from rain, the height is usually between 3 m and 3.5 m)*
  - *0.9 m above the ground we have 1 lateral branch every 15-20 cm, that's to say 10 to 13 lateral branches per tree.*
- *Subsequent growing seasons*
  - *Full bearing between 15 and 20 t/ha*
  - *Remove the most vigorous fruiting branches after 2-3 years of bearing*
  - *With very productive rootstocks and varieties it's advised to remove 20% to 40% of every new shoot each year*

Axis

Important points to take into account

- ***Maintain moderate growth***
  - *Rootstocks : dwarfing*
    - *Gisela 3, Gisela 5, Tabel®, Piku 1, Krymsk 6 ?*
- ***Branching***
  - *Varieties*
    - *Growth habit : semi-spreading, spreading, willowy*
    - *Avoid upright habit (Burlat, Rainier, Lapins)*
    - *Good branching and wide angles*
  - *Scoring in January/February (years 2,3 and sometime 4) above buds not perpendicular to the row*
    - *Remove branches perpendicular to the row*
    - *Remove lateral branches when its diameter is more than 50% of the leader's.*

Axis

Plantation

Early 2nd leaf

End 3rd leaf

End 5th leaf

Axis

Trials in progress

1 – Plantation 2012 at Balandran

- *Varieties*
  - *Regina*
  - *Balrine*
- *Rootstocks*
  - *Tabel®*
  - *Piku 1*
  - *Weiroot 158*
- *Spacing*
  - *Between the trees : 1.5 m*
  - *Between the rows : 4 m*
  - *Density : 1666 trees/ ha*

2 – Plantation 2012 at La Tapy

- *Variety : Regina*
- *Rootstock : Gisela 6*
- *Spacing*
  - *Between the trees : 1.5 m*
  - *Between the rows : 4 m*
  - *Density : 1666 trees/ ha*

Biaxis & palmette

Aims

- Using 2 or more axis divides the vigor of vigorous semi-dwarfing rootstocks and limits the development of the trees (height, width)
- The greater the vigor, the more axes are needed

Spacing

- Between rows: 3.50 m - 4 m
- Between trees
  - Biaxis : 2 m-2.50 m
  - Palmette : 3 m - 3.50 m

Biaxis & palmette

Compared to the axis, these training systems allow the vigor of the lateral branches to be controlled, especially with varieties with upright and semi-spreading growth habit or with poor branching and narrow crotch angle(Burlat, Summit, Rainier, Lapins).
Training and pruning : close to axis

Points to pay attention to :

- *Axis - well balanced*
  - *If not : most vigorous one must be put at an angle and less vigorous one must be tied vertically*
  - *Wire: use twisted wire*

Biaxis & palmette

Same variety : left : 3 axis, right : one axis

Early 2nd leaf

End 4th leaf
(height : 2.90 m)

Palmette/Maxma 14 end 6th leaf

Biaxis & palmette

Ctifl

- Evaluation of new varieties
  - Training system routinely used since 2009
    - Varieties : 40 red and blush
    - Rootstocks : Gisela 6, Weiroot 158, Maxma 14

La Tapy

- *Trial planted in 2012*
- *Variey : Regina*
- *Roostock : Gisela 6*

Upright Fruiting Offshoots | UFO

Why ?

- Easy to protect from rain and insects
- Easy pruning

Training system develops by Matthew Whiting (USA)

Trial

- One planted in 2014 at Ctifl
  - 15 varieties : Burlat, Early Star, Folfer, Ferdouce, Samba®, Satin®, Summit, Rainier, Van, Kordia, Belge, Skeena, Rubin, Ferdiva, Regina.
  - Rootstock : Maxma 14
  - Trees planted to a 30-degree angle
  - Spacing
    - Between rows : 3.5 m
    - Between trees : 2 m
    - Density : 1428 trees/ ha

UFO

Pruning 1st year

- *Rub off all buds on the basal part of scion (at plantation)*
- *Remove lateral shoots*
- *Tieing down the axis on the lowest wire (30 cm above ground when the axis growth is at least 10-15 cm long.*
- *Tie upshoots on the treillis wire*

Skeena/ Maxma 14 : before 2nd leaf

Basal buds did'nt removed at plantation : side shoots at the end of 1st year

Pruning 2nd year

- *Impose bud activation techniques to stimulate vertical shoot formation*
  - *Removal of fruit buds on the spurs (at Balandran)*
- *Remove too vigorous upright shoots*
- *Objective : a vertical shoots every 15 cm (7 to 10 per tree)*

UFO

Planted at a 30-degree angle

Early 2^{d} leaf

Belge/ Maxma14, 2nd leaf, 15 June 2015