CULTIVATION GUIDELINES FOR CAMEO®

Experience from nearly 20 years of growing and marketing Cameo® Caudle apples

History:

Discovery and first steps:

Cameo® is the brand name and Caudle is the variety name.

Caudle is a chance seedling discovered in Mr Darel Caudle's Red Delicious orchard, in the US in the late 80s. At that time, rootstocks were sown from pips recovered from processing fruit. If, once the orchard was planted, the bud did not grow, the rootstock would grow and produce fruit from a new variety. Mr Caudle had not replaced this "wrong" tree and the Mexican pickers were instructed to carefully avoid this tree and were allowed to pick the apples for their own use... The message that these apples were better than the official ones quickly spread.

Pépinières du Valois acquired the European rights for the variety and the first commercial orchards were planted in the late 90s in France and England and early 2000 in Germany and Switzerland. Since 2007, Pépinières du Valois / Dalival propagates a coloured and striped mutant of Caudle, named Cauflight. There are also several blushed mutations of Caudle, among which Caured and Cauval.

From left to right: Caudle, Cauflight, Cauval

Qualities and main characteristics:

Cameo® has outstanding and very consensual eating qualities: crisp, juicy with a good balance between sugar and acidity. The variety is very productive with good fruit sizes. Storage is exceptional and enables marketing from October to August. Shelf life is excellent and Cameo® does not bruise easily, therefore is ideal for self service.

Cameo® managed variety:

The group was created in 2001 and the company Cameo Europe was founded in 2006. It has the exclusive rights for the variety, delegated by Dalival. Its missions are:

- Planning and financing the promotion for this new variety to:
  - => consumers and trade;
  - => growers in order to follow plantings and volumes.
- Providing technical coordination both in orchards and pack houses.
- Ensuring compliance with contracts between growers, marketers and Dalival.
- Coordinating the group.

Why plant Cameo®?

With 20 years of experience and a lot of perseverance from all members, Cameo® has its place, today more than ever, in a grower's portfolio.

Commercial benefits:

- Cameo® is very well suited to the modern retail's requirements:
  - Does not bruise easily,
  - Good storage and good shelf life,
  - Good eating qualities.
- It is an alternative to imported products:
  - Consumers are more and more aware to locally grown products.
  - Retailers must, for their image, list local products.
- Cameo®, due to its excellent storage potential, can be marketed after Gala, in the second or third part of the season.
- Some retailers wish to associate their premium brand to Cameo®.

Benefits for the farmer:

Cameo®'s cultivation had advantages for the grower:

- The coloured sports of Caudle provide a significant increase of grade-outs.
- Cameo® is productive with good fruit sizes.

Benefits for the pack house:

Practical and marketing experiences validated:

- A very long storage potential which allows:
  - to spread the selling period,
  - to maximise the use of the storage and packing facilities.
- The fruit does not bruise easily which makes it easy to work in the grading machine.
- High grading and packing yields.
- Exceptional holding of the pallets waiting to be shipped.

Climate and soil conditions:

Cameo® is currently planted in Kent in England, near the Lake of Constance in Germany and Switzerland, and in the Czech Republic near Prague.

Generally , Cameo® has to be grown in an area where the is a big difference of temperature between night and day during the 2 to 3 weeks before picking, in order to get a good colour. Therefore, Cameo® is a very good variety for the North of Loire and North of Europe.

Fruit growers who wish to grow Cameo® in areas with very hot summers, must first ensure that their soil and climate will allow them to obtain a crop which fruit sizes suit their markets, and avoid sunburn.

Choice of plant material, land and planting system

Quality of the trees:

Plant material quality is a key element for a successful orchard. The variety is difficult in terms of nursery production and therefore Dalival chose to produce exclusively knipbooms trees (2 year old trees).

Rootstocks:

The variety being vigorous, the rootstocks conferring a growth close to M9 Pajam® 1 Lancep or M9 T337 are suitable to most of the orchards. They allow a good control of the crop load and reduce biannual bearing.

Soil and water:

Planting in good soil is one of the most important conditions to give the trees a good start.
Priority should be given to a middle to well fertile soil, deep, without obstacle for the roots, drained or naturally draining.
Soils susceptible to asphyxia should be avoided.
Soils with low water retention (drying) should be avoided or will require a sprinkler watering system if enough water is available or a micro spray under canopy.
On the contrary, it is not recommended to plant in wet soils to avoid canker and scab.

Planting systems and density:

Plant in rows with a north-south orientation if possible.
The spacing of the rows depends on the final height the trees are expected to reach. The minimum spacing must correspond to the maximum height of the trees in summer (including long shoots).
The planting distance within the rows depends on the expected growth of the trees. It is influenced by soil conditions, site history (replantation of virgin land), possibility for irrigation and fertilisation, planting height of the trees, tree quality, etc.
In order to get a good crop per hectare, the recommended density with M9 type rootstock is 3.50 to 4 meters between the rows and 0,8 to 1.20 meter in the row.

Plantation:

Plantation:

Plant on mounded rows in order for the bud union to be slightly above the ground. The stronger is the soil, the higher the bud union should be planted (above soil level). Depending on the growth during the second or the third year, the rootstock might be partly brought off the ground. For advice on planting depth, please contact your local advisor.
Important: try to plant all trees at the same height above the ground. This avoids too many differences in the vitality and growth of individual trees in later years.

Right after planting, pressing the soil with the feet enables the roots to make a good contact with the soil. Especially for spring planting, watering or irrigation (at least 3 litres per tree) is necessary for a good start.
Trees that have been in cold storage for a long time will have a better start if they are placed in water for 24-48 hours so that they can soak up water completely.
Make sure that the trees do not dry out when they are brought to the orchard and distributed in the fields. Store the trees away from sun and wind until immediately before planting.

Fertilization:

The use of organic matter can stimulate growth. Peat compost mixed with soil in the planting hole, combined with an irrigation system are very helpful in overcoming problems at planting. Laying compost (e.g. mushroom compost) at the bottom of the tree protects the soil from drying out quickly (10 to 15 litres per tree seems a good measure). Watch out for mice and rats when using large amounts of organic matter.

Mineral fertiliser can be used, but not in concentrated form or in direct contact with the roots. Phosphorus in particular promotes the growth of new roots in spring. The use of higher concentrations of fertiliser directly in the planting hole can lead to root burn, especially in dry conditions.

Tip the trees:

Right after planting, do not hesitate to tip (cut back) the longest / thickest branches. This will decrease the fruit set and desynchronise the tree (and therefore maintain a good balance between fruit set and growth / avoid biannual bearing)

If the branches in the upper third of the tree are too strong and have a closed angle (which could compete with the axis), they must be completely removed (cut back direct to the trunk).

Pollination:

A good pollination is necessary to obtain high fruit quality. Fruit size as well as sugar content and firmness are positively influenced by seeds ripening in the fruit.
The variety is not very susceptible to blossom fall even when spring weather conditions are difficult.
The blossom date is similar as Gala.

Use of Malus as pollinators:
For good pollination, it is advised to plant 8 to 10 % of the amount of trees in pollinators, while choosing 2 varieties of pollinators in order to cover the entire blossom period among Malus INRA Perpetu®
Everest and Malus Golden Gem or INRA Baugène®. They are usually planted on the scaffold poles in a cross distribution.

Use of commercial varieties as pollinators:
We recommend to plant 1 pollinator every 10 tree in a cross distribution.
Systems where 2 varieties are planted in blocks are also possible, with for instance, an alternance of 4 rows of Cauflight/Cauvil and 2 rows of the pollinator variety. Suitable varieties are all diploid variety with a similar blossom date .

Pruning:

Shape of the tree:
Cameo® is a variety of medium to strong growth, which naturally produces branches and facilitates the establishment of a central leader or a fruit wall. The bottom of the tree grows stronger and leads the tree to grow up to 3.3 to 3.8 meters. Therefore strong and high stakes and trellis are required.
Any pruning to limit the height leads to an imbalance situation and impacts yield.
During the juvenile phase, only the very upright branches must be bent (tied down).

Development of fruit branches:
From third leaf, focus on open and middle strong branches which will easily bend under the weight of the fruit and thus provoke the break of flower buds. Bend thick vigorous branches for future production.

Flower buds and brindles will bring sufficient bloom to ensure fruit production. It is recommended to destroy flower buds (mostly underneath the branch) to ensure optimal colour and regulate the crop load for the following year (flower bud return) while creating light wells; the thicker is the branch, the less buds must be destroyed.
Until 3rd / 4th leaf, in the top third of the tree, try to maintain a good balance between fruit buds and new branches, i.e. do not hesitate to cut 30 to 50% of the fruit buds to initiate the break of new branches. This will avoid biannual bearing from the earlier stage.

Management of the tree growth:

Cameo® is a vigorous variety. In case of excessive growth, it is possible to cut the roots in winter, on one side of the tree (with a blade placed between 40 to 50 cm from the trunk and about 40 cm deep). According to growth recovery, it is possible to cut the other side's roots one year later.

Excellent results were also obtained with Regalis (prohexadione calcium). The manufacturer recommends a first application when shoots issued from flower buds are 2 to 3 cm long or have 3 to 5 developed leaves, and a second application 3 weeks to 1 month later. Please refer to your local technical advisor to get the usual doses.

Regalis is recommended in case of frost, light fruit set or biannual bearing (low crop year).

Be careful not to apply any hormonal products during thinning which could interfere with your chemical thinning programme. A 10 days delay is necessary between chemical thinning and the application of Regalis.

Winter pruning:

It is necessary to:

- shape the trees;
- regulate tree vigour (remove suckers);
- ensure the renewal of fruit bearing wood;
- remove imbalanced branches;
- allow maximum crop on brindles;
- ensure maximum light inside the tree (help with coloration).

Summer pruning / coloration:

In vigorous orchards, or biannual bearing years (low crop year), summer pruning will favour coloration by removing suckers and the apples placed at the bottom or in the middle of the tree. Summer pruning, by taking leaves away, has a negative impact on the (too big) fruit size, which is important if the crop load is too weak. If the apples from the top of the fruit are getting too big, summer pruning is efficient too.

Crop load management:

Managing the crop load is the key to grow Cameo® successfully. The variety is susceptible to biannual bearing and in case of a heavy crop load, it is important to control thinning.

Production mainly takes place on fruit branches placed horizontally, on which it is necessary to ensure a good distribution of the brindles. It is also necessary to pay special attention to fruit on 1 year old branches which are often too small.

A very precise pruning and a strong thinning will be necessary in years when the number of flower buds is important, targeting on a ratio growth of the tree / number of fruit.

For instance, if a tree has 600 flower buds, it will be necessary to reduce this number to 100 to 130 by adequate pruning and thinning.

Chemical thinning:

Cameo® is known as being moderately sensitive to ethefon before blossom and very sensitive after bloom. ATS can also be applied while being extremely careful to wet weather conditions just after application (risk of phytotoxicity on the leaves).

ANA (Rhodofix) and 6 BA can be applied alone or mixed, when the fruit starts to grow.

For doses, sequences and stages of application, a technical advisor must be consulted.

NB: while using a growth regulator, such as Regalis, it is necessary to respect a period of 7 to 10 days between the application of the Regalis and ANA, to avoid misshapen fruit.

Metamitrone (Brevis) can be used for late applications and catch up. This product acts by blocking photosynthesis. Be careful while applying before cloudy periods which could emphasize the effect of the product).

Mechanical thinning:

In weaker orchards, the use of the Darwin machine can be interesting as this operation provides added vigour. It should therefore be avoided if the orchard is too vigorous.
It is noticed that the machine is less efficient on dry leaves that on wet leaves.
The machine is used in a pre-blossom stage insisting on the tops of the trees, ore difficult to reach.
For dates of use, and rotation and driving speeds, it is advised to consult a local technical service.

Hand thinning:

Distribution of the fruit among the trees is not naturally consistent, overloaded and under-loaded branches can be observed. **Therefore hand thinning is necessary in most situations**. Beyond fruit size, fruit packs will have colour issues.
A quantitative hand thinning in July it will help reducing the risk of biannual bearing, by focusing on a ratio maximum number of fruit per tree / target of fruit size and yield.
For instance, if the expected yield is 50 tons / ha, in an orchard of 3000 trees per ha: only 100 apples per tree are needed, i.e. 50 apples on each side of the tree maximum (50000 kg / 3000 x 6 apples per kilo).
A quick (average of 50 hours per ha) qualitative hand thinning, realised mid July or after, is recommended. It is usually coupled with suckering, and the goal is to reduce the number of fruit per cluster at the top of the branches and to take off fruit not satisfying the specifications.

Management of irrigation:

A precise irrigation management appears to be a key point for a successful Cameo® orchard.
If the crop load is low, a daily water shortage will prevent any excess of oversize and can help with the colour.

Fertilization:

The mineral supply in the soil is very important for the outer and inner fruit quality and especially for the shelf life of the fruit after storage. A soil analysis is necessary before planting so that deficiencies and imbalances can be corrected.
The amount of fertiliser applied depends on the soil conditions, the macro- and micro-nutrient content and the crop forecast. A soil analysis and a discussion with the local adviser is the basis for a good fertiliser programme. It needs to be suited to each situation, soil type (texture / structure), and above all, the fixation coefficient (the cation exchange capacity which measures the soil fertility).
Some nutrients should be given special attention: Calcium (Ca) and Magnesium (Mg).

Always follow local regulations for fertiliser use.

Ground fertilization:

Cameo® is a vigorous variety. For mineral exports Dalival applies the following coefficients:

Per tonne of fruit harvested per ha:

- => NITROGEN: 1
- => PHOSPHORUS: 0.7
- => POTASSIUM: 1.3
- => MAGNESIA: 0.6
- => CALCIUM: 0.9

For a yield of 70 Tonnes / Ha , it should be added to compensate the annual consumption of leaves and apples:

- => 70 Units of NITROGEN
- => 50 Units of PHOSPHORE
- => 90 POTASSIUM units
- => 40 MAGNESIUM Units
- => 60 Units of CALCIUM

- **Nitrogen:** as a standard, the addition of nitrogen can be split:
    - 50% at bud break
    - 40 % at the beginning of June (after the fruit has been definitively hung)
    - and 10% for winter storage, just after harvest (before leaf fall).

Late applications of nitrogen can cause quality problems (like lenticels, poor colouring, etc).

- **Phosphorus:** Phosphorus is placed at bud break

- **Potassium:** Potassium is often split in light soil (sand tendance):
    - 50% at bud break
    - and 50 % in nitrogen at the beginning of July in case of heavy crop load.

In clayey (and/or silty) soil, it can be applied in one go.

- **Magnesium:** Magnesium is an important element in the leaves, especially for assimilation (photosynthesis). Magnesium deficiency will be observed in the older leaves, because of the Mg being transported from the older leaves to the young growing stems. Leaves with a large Mg deficit no longer function and cannot supply the fruit with nutrients.

To maintain the leaves dark shiny green and functional, it is necessary to spray magnesium between blossom and early August. It is applied in one go and we prefer in April / May.

- **Calcium:** Calcium as fertiliser is a very important element for the cell walls especially in the fruits. Many physiological problems can be avoided if the fruits contain sufficient Ca.

A good Ca reserve in the trees is therefore important. Sufficient supply in the soil and sufficient root activity increase this reserve.

If the trees are excessively vigorous and the growth phase is too long during the season, the Ca reserve will be used up by the growing branches. The Ca transport to the fruits is thus significantly reduced. This problem does not occur if the vitality of the trees and the yield are balanced.

60 units/ha (Coef. 0.9) of calcium will be added as lime (or calcium plaster) in January. ALWAYS remember to keep at least 40 days before adding any organic matter (as there is a risk of degrading the organic matter if it is placed too close together)!

Once again, it is necessary to readjust these export coefficients according to the soil and leaf analyses (possible correction to +/- 10 to 15 % for each element).

<u>Leaf fertilization:</u>

In years of lower crop load, a leaf fertilization with a supplement of calcium is recommended to limit physiological disorders (such as bitter pit). In this case, a form of CA nitrate should be chosen for the second nitrogen supply in June.

In years of overload, nitrogen and potassium will be important to ensure fruit size and colour.

Calcium and magnesium react very antagonistically and should therefore be used separately. If there is enough young leaf mass, calcium (several times per season in combination with manganese (Mn)) and magnesium (combined with boron during and immediately after the flowering period) can be sprayed alternately. Individual models for nutrient supply to the leaves can be discussed with the local advisory service.

Pests and disease:

Plant protection measures in Cameo® orchards must be carried out according to the commonly used Integrated Pest Management spraying models of the country of production. Based on regional experience, it must be done with approved products, application rates and application instructions for the country or region.
Each producer must follow the crop protection guidelines and bylaws of their Cameo® sales organisation. Individual problems must be discussed with the local technical advisor.

Cameo®'s susceptibility to pests and diseases is now well known. The information below must be considered to establish the spray programme:

Fungal diseases:

- **Scab: susceptible**. Well protect against strong primary infection. Pay attention also to a possible secondary conidial infection.
- **Powery mildew** on leaf: the variety is not particularly susceptible. To be monitored.

- **Canker: susceptible, indeed very susceptible** in young orchards or infected environment.

Acid soils are particularly favourable to canker. In this case, an option is to regulate the pH by adding ground lime.
The presence of livestock or manure emitting ammonia in the neighbourhood also favours canker.
Adjacent plants infested with Nectria will increase the risk of infection of the Cameo® trees.

Measures to avoid losses due to nectria infections.
Once infected, most Nectria infections develop systematically in the Cameo® trees.
Normal growth level: too weak or strong vigour can especially promote the calcium uptake. A tree with a low calcium cannot withstand the pressure of fruit tree cankerl.
Reduce the pressure of Nectria infections by scraping and cutting back older and younger canker infections, also in plants in the neiboughoud.

Hygienic measures: once infections are visible, they must be removed from the orchard. Regular inspections are necessary.

Chemical protection against Nectria, especially during the most important infection periods (during autumn when the leaves fall and weather conditions are rather humid, during spring at bud break).

As Nectria is a wound parasite, wounds should be avoided as much as possible or bypassed with a fungicide that protects against Nectria. At leaf fall, after pruning, after bud scales or unfertilised flowers have fallen, spraying with an appropriate fungicide may prove necessary or beneficial. Cankers which have been cut back or scraped should also be covered with a paste containing an anti-nectria fungicide.
When cutting branches, always ensure that the cut not straight to the trunk but leaving a piece of branch of 1 to 2 cm). Thus any canker infection of the wound is not directly in the trunk (vital trees can still successfully control Nectria); and a smaller diameter injury will also heal faster than a shallow cut along the main branch.

Tool used to scape the canker

● Mouldy core, eye rot and storage diseases: **susceptible, even very susceptible** due to the open calyx. It is recommended to apply fungal treatments in case of wet weather during blossom time.

A German working group led by Dr. Scheer of the research station KOB over the years 2017-2020 has studied the pathogens involved in mouldy core and some possible treatments. Since then, the German supra-regional Plant Protection Advisory Service recommends "... If possible, shortly before precipitation, apply a coating fungicide such as Sercadis (0.1 l/ha/m) mixed with a product containing Captan (Dithianon). product. This would have an effect on powdery mildew as well as an effect against various calyx and core rot pathogens .

Pests:
Cameo® is as susceptible as Gala or Golden Delicious to codling moths, spiders, aphids, …

Picking:

Cameo® is a rather late variety and picking starts 4 to 5 days before Braeburn. Its harvest fits well in a farm picking programme. Harvest yields with Cauflight are very high and picking using machine assistance is possible.

Sun burns:
In case of very hot summers, or in weak orchards, talc can be applied to avoid sunburns.

Quality picking specifications to satisfy the Cameo®marketing specifications:

● Colour:
Ground colour: green or green turning to yellow (F2-F3 code Gala CTIFL); do not wait until the ground becomes yellow (F4-F5). 40 % minimum top colour; do not wait too long for colour to avoid the fruit to become aromatic (1st pick R4, 2nd pick R3-R4).
● Starch reversion: pick between 5(C) and 7(C) for an optimal picking. Last pick must not be after 8(C) for a good storage.
● Firmness: between 7 and 8 kg/cm²; target: 7,5 kg/cm²
● Sugar: 12,5° Brix minimum; the optimum is 13° Brix.

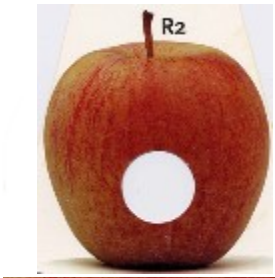
Picking
First pick: when 20 to 30% of the fruit is 60% red.
Two picks (3 for Caudle) are recommended to get consistent batches and a good colour level.
Last pick: 40% red minimum. Do not wait too long for fruit in the middle of the tree to avoid the fruit to become aromatic. A yellow background colour does not allow good eating qualities for long term storage.

In years of low crop load, when the fruit size is big and therefore the apples are heavy, it is recommended to stick the fruit.

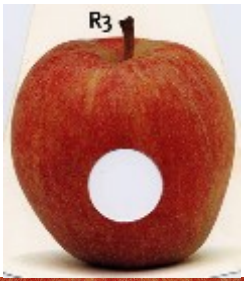
Like any other club variety, Cameo® has specification for a class 1 product and it is necessary to grade at picking.

PICKING RECOMMENDATIONS

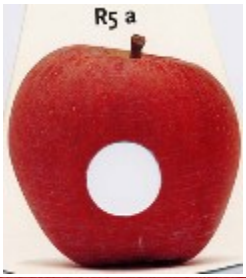
TOP COLOUR



TOO EARLY

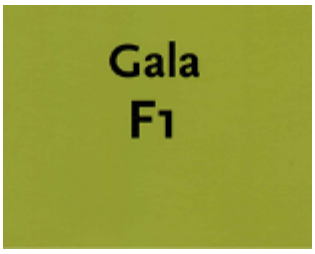


CORRECT TO GOOD

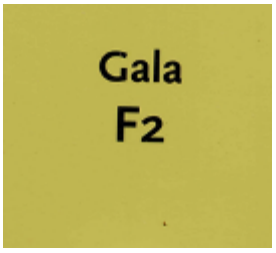


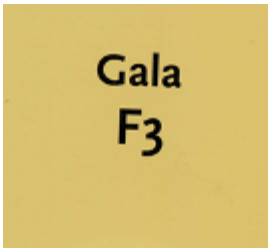
OVERMATURE

GROUND COLOUR



TOO EARLY





GREEN TURNING YELLOW

OVERMATURE

STARCH REVERSION

3(C) IMMATURE

5(C) BEGIN TO PICK

8(C) OVERMATURE

Storage:

Normal air storage: Cameo Europe SAS asks for fruit stored in normal air stored not to be sold after November 30th.

CA storage: the German coop Mabo uses the following regimes:

2-3 weeks after harvest i.e. during and after filling the store:

- **Cold storage conditions: 1°C** to avoid development of mouldy core pathogens
- ***CO_2 content: keep LOW at max. 0.7% CO_2***

The increase in CO_2 caused by the fruit itself can easily cause CO_2 burns (aerating may be more efficient than adsorber)

First CA-Phase following 2 months:

- ***Reduced 1.5% CO_2 for underdeveloped fruits or shadow fruits,***
- If possible small 1.5% CO_2 for normal or well-developed fruits,
- About 1-1.5% O_2 (set O_2 at 5%, then let O_2 down in the store itself),
- **1°C to avoid development of mouldy core pathogens**

Second CA-Phase after 2 months:

- ***Reduced 1.5% CO_2 for underdeveloped fruits or shadow fruits,***
- 2-3% CO_2 for normal or well-developed fruits,
- About 1-1.5% O_2
- **1°C to avoid development of mouldy core pathogens**

→ **Mouldy core:** it is very important to keep the „storage temperature“ at 1°C in order to avoid the development as much as possible.

These storage recommendations are provided as information and Cameo Europe SAS can not be held responsible in the event of storage issues.

Smartfresh® 1-MCP:

The supplier gives the following recommendations:

Variety recommendation at harvest and specificities				
Firmness (kg/cm²)		Starch (1-10)		Special indication for the variety
Min	Max	Min	Max	
6	8.5	4	8	The application must take place the day after the last fruit have been harvested (the filling of the store must not exceed 6 days). The CO_2 level must remain below 1% during the filling and during the 4 weeks following the application. This monitoring of CO_2 also applies to normal air storage.

All standard recommendations for the applications of Smartfresh® on apples applies.

CAMEO EUROPE SAS
CHÂTEAU DE NOUE—02600 VILLERS-COTTERETS—FRANCE
www.cameo-europe.com