CULTIVATION MANUAL

EVERBEARING STRAWBERRY VARIETIES

2020

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Flevo Berry

BREEDERS OF THE *"FLEVO BERRY CONCEPT"* STRAWBERRY VARIETIES

Introduction

Since the start of our breeding program in 1999, we have adopted an integrated approach to breeding. We listened to growers who asked for a strawberry season that is as long as possible. Growing quality strawberries year-round is now possible by using various planting times with June-bearing varieties, but everbearing varieties are also an important key to this.

Another goal of the Flevo Berry concept is to develop strawberry varieties that taste good and can be grown with respect for people and nature.

Commercial companies, research organisations and technical cultivation advisers play an important role in the development and successful cultivation of our varieties in various cultivation systems and cultivation regions. Each variety has its own characteristics, and finding the best way to grow them is an ongoing interesting challenge.

Unlike June bearing varieties, which have a reasonably defined vegetative and generative stage, everbearing varieties continually balance between vegetative and generative stages. As these growing stages can be somewhat controlled, we are always working to find the most suitable balance for each variety.

In other words, it is impossible to present an exact blueprint for the cultivation of everbearers. With this document we will try to indicate the directions in which to steer and which knobs could be adjusted. We hope this guide will also provide food for thought and discussion.

Flevo Berry is certainly open to other refreshing insights as well, so that together we can bring knowledge development for growing our varieties to an ever-higher level.

Picture 1: Florentina

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1. Everbearers or day-neutral varieties?

The terms everbearer and day-neutral varieties are often used interchangeably. A day-neutral variety is an everbearer, but everbearers such as we grow in North-West Europe are only day-neutral at a daily temperature <10°C. Varieties that we refer to as everbearers are, in fact, long-day plants because they induce more flowering under long-day conditions.

1.1 Day length and temperature

With an everbearer, the flowering induction is optimal when the daily temperature is between 15 and 21°C, in combination with a day length of > 14 hours and good growing conditions. Optimal temperatures for flowering induction depend on the variety. Based on experience and research, it may be possible to steer cultivation more precisely in this respect in the future.

An everbearer also produces flowers at lower temperatures and on short days, albeit at a much lower level. When the temperature rises above 25°C under short-day conditions, there is virtually no more flower formation.

Under long-day conditions, there is still flower formation even at daily temperatures > 25°C, but at > 32°C, the flowering induction is nil. At a temperature below 10°C, the day length no longer plays a role.

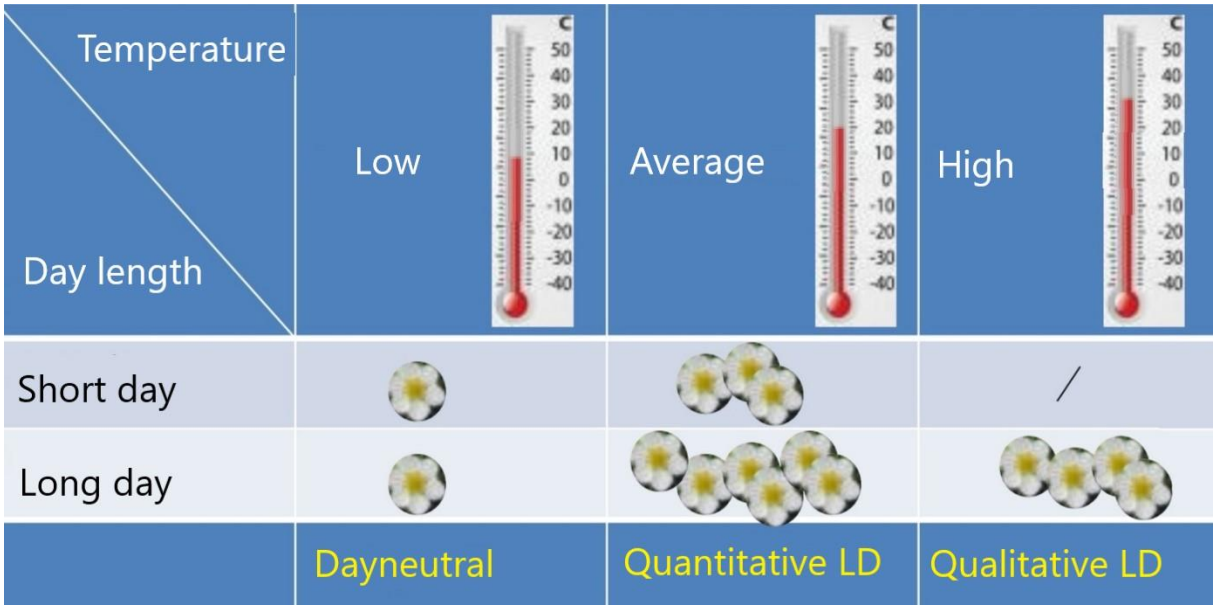

Table 1: PC Hoogstraten 2014, Tom van Delm

In the region of North West Europe, the daily temperatures are often lower than 15 to 21°C, so the flower formation will not always be at the optimal level. This is often not an issue because too many flowers at once is not desirable either. During warm periods where the day length is > 14 hours, the maximum level of flower formation is reached.

In order to get the flower formation started earlier or to allow it to continue for longer throughout the season, (temporary) covering with tunnels can be useful. This allows the daily temperature to be raised to a higher level. In heated glass greenhouses, the optimal daily temperature can be maintained fairly well year-round, and a longer day can be created with lighting.

Not only the day length and the temperature determine the generative or vegetative direction that the everbearer takes. The general condition of the plant and many environmental factors also play a role in flower bud formation.

1.2 Influencing flowering induction

Factors that influence the flowering induction in everbearing varieties are day length, light quality and light level, nutrition and watering, plant type, transplanting, pot size, substrate, maintenance work on the plants, leaf area, water stress, the climate in the greenhouse, tunnel or in the open air, the plant load and the general plant health and plant structure.

The table below shows which actions can generally result in a vegetative or a generative response to the flowering induction in everbearers.

Action	Vegetative response	Generative response
Climate		
Greater difference between daily and night temperatures	-	+
Longer day	-	+
Shorter day	+	-
Lower pipe temperature	+	-
Higher pipe temperature	-	+
Faster temperature drops at the end of the day	-	+
Slower temperature drops at the end of the day	+	-
Higher daily temperature	-	+
Lower daily temperature	+	-
Higher humidity	+	-
Lower humidity	-	+
Water and fertilization		
Higher EC substrate and water	-	+
Lower EC substrate and water	+	-
Higher substrate moisture content	+	-
Lower substrate moisture content	-	+
Longer dripping time	-	+
Shorter dripping time	+	-
Lower dripping frequency	-	+
Higher dripping frequency	+	-
Advance the first dripping session	+	-
Postpone the first dripping session	-	+
Advance the last dripping session	-	+
Postpone the last dripping session	+	-
Maintenance work		
Little leaf picking	+	-
Lots of leaf picking	-	+
Frequently cutting off runners	+	-
Rarely cutting off runners	-	+

Table 2: Klaas Plas, Berry Konsult

1.3 The balance between generative and vegetative

- Generative: development of flowers, less foliage
- Vegetative: leaf development, fewer flowers

A balanced plant load is important for the continuity of flower bud formation, for the quality of the fruit and for the development of the crop with a good leaf volume.

When the plant material already contains many formed flower buds, an everbearer variety usually starts with a fairly generative cultivation phase. By quickly removing the first flower trusses, this generative growth can be diverted into more vegetative growth. When mini-tray plants or tray plants are used, these first trusses are usually not removed, because a first large harvest flush is often desirable.

Problems can arise with a very generative crop, often carrying many fruits. In these situations, the fruits present will consume almost all the sugars, leaving insufficient energy for growth. Because the plant spends a great deal of energy on cultivating a large number of fruits, the development of new trusses in a generative crop is also compromised. Flower clusters already initiated in the rhizome may be lost due to a lack of energy.

Especially during the rearing of the first harvest flush, the plant load can be quite high. After all, there is as yet only a limited number of leaves in relation to the number of growing fruits. From flowering until a major harvest flush has passed its peak, the plant will struggle to regain its balance. If the growing conditions have been good from the start of cultivation and during the rearing of the large flush, the plant will not be too stressed. Then the balance between truss formation and the growth of the plant will gradually be restored.

Excessively vegetative growth is accompanied by a delay in flower bud formation. In addition, many runners and side crowns may then be formed. A switch from vegetative growth to more generative growth can be stimulated by cultivation measures, as shown in *table 2* on the previous page.

Furthermore, flexibility in the composition of the nutrient solution can help steer the crop in a desired direction. The trick is to make timely adjustments, even before the crop is in an undesirable mode. For example, adding, or not adding ammonium to the feed, or a different K:Ca ratio can change a growth situation.

Double trusses

Sometimes it can happen that a vegetative growth or a well-balanced plant is abruptly disrupted. Several very cold nights, extreme heat, an intermittent severe water shortage or the removal of overly rigorous leaf volume can cause the plant to go into a generative spasm.

In such situations, a double truss often emerges from a crown, but does not have a new growth point (new leaf position). This double truss then also means the end of the productive life of the relevant crown.

Picture 2: double truss

2. Various plant types

Like June-bearers, everbearers also come in different plant types. How all types of plants are cultivated also determines the suitability for a planned cultivation strategy.

The most commonly used plant types for everbearing varieties

- ***Frigo A plant***. This plant type is grown in an open-ground propagation field and has a rhizome diameter of about 12 to 15 mm. Each plant has 1 crown and 1 to 2 flower trusses. This is the most commonly used plant type for outdoor cultivation.

- ***Frigo A+ plant***. These plants are also grown in a propagation field in the open ground. The rhizome diameter is usually 15-18 mm. These plants usually have 1 or more crowns, with 2 to 3 flower trusses formed in it. This type of plant can be used for open-ground cultivation as well as for substrate cultivation planted in early spring, provided that the growing conditions are good right from planting.

- ***Frigo plug plant (85cc).*** During the course of August, a fresh cutting is planted in the plug, from which a small root ball plant grows, with an average of 1.5 crowns per plant and 2 to 3 trusses formed. After transplanting the following spring, this type of plant will start up quickly. No major harvest peaks and drops are expected.

- ***Fresh plug plant (85cc).*** Early in July, a fresh cutting is planted into the plug, from which a small root ball plant grows. This type of plant is particularly suitable for a ground crop with overwintering in a tunnel, for a large peak harvest in May.

- ***Frigo minitray plant (135cc).*** A cutting is planted in the tray from mid-July to early August. In general, a plant grows out in the autumn, with 2 crowns and about 4 formed trusses. Regrowth after planting out in spring starts easily, followed by a modest first harvest peak.

Picture 3: Mini tray

- ***Fresh mini tray plant (135cc).*** A cutting is planted around 1 July, after which the mini tray plant that has grown from it can be planted in a greenhouse around 20 August, intended for winter cultivation under assimilation lighting.

- ***Frigo tray plant (230cc).*** A cutting is planted in the tray from early July to the end of July. At the end of November and early in December, the plant has an average of 2 to 3 crowns and 4 to 6 formed clusters. Regrowth after planting out in spring starts easily, followed by a significant first harvest peak.

- ***Tray plant (230cc), overwintered in a greenhouse.*** A cutting is planted in the tray from early July to the end of July. Generally, a plant grows out in the autumn with 2 to 3 crowns and 4 to 6 formed trusses. During winter, the temperature is kept at a minimum of 7 degrees, and preferably not much higher. In this plant type, newly formed flowers appear more quickly than when using a refrigerated plant. This means that the dip in the harvest is smaller.

    - At temperatures under 10°C in combination with a short day, everbearers are not very receptive to flower formation, although it does not halt completely. With wintering tray plants, you can choose to encourage extra early formation of spring flower buds, or choose not to:
        - ***Encouraging early flower bud formation***: from 1 February, keep the night temperature in the winter greenhouse at a minimum of 7°C and during the day at 12°C, combined with cyclical lighting to give the plants the feeling of a day length of at least 14 hours. This will help the formation of flowers to get under way. Only remove winter flowers if they are of insufficient quality and if the plant is not yet sufficiently balanced
        - ***To discourage early flower bud formation***: keep the greenhouse cold, but not below 7°C and do not illuminate. Only remove winter flowers if they are of insufficient quality and if the plant is not yet sufficiently balanced.

If the plant grower is informed in good time about the specific wishes for the plant material, its propagation can be broadly steered in that direction. Examples are plants that have the most regular harvest progression in production cultivation, or plants that will show a large harvest peak in a desired period.

The choice of the best type of plant material mainly depends on the grower's wishes, and the cultivation system and medium in which the cultivation takes place. Choices may be dictated by a variety of wishes and objectives:

- Cultivation in the field or on substrate
- Cultivation on outdoor table tops, under rain hoods, in a tunnel or in a greenhouse
- The specific period in which the harvest is desired or not
- The intended planting time, a cool spring or a hot summer
- Always the best quality, or the maximum production
- A flat work pattern at the farm
- A desired harvest peak with high picking performance
- A uniform harvesting pattern

3. Spread of the harvest

To ensure stable sales, it may be desirable not to fill the entire farm with one type of plant material at once. There are several ways to achieve this:

- Planting different types of plant material simultaneously.
- Planting different types of plant material at different times.
- Planting the same type of plant material at different times.

The variation in planting times and plant types usually results in a flattening at the farm level of the quantity of strawberries to be harvested. In order to match the planting data of the different types of plant material as closely as possible with the ideal harvest forecast, it is important to know the history of the plant material.

Knowledge about the number of growing degree hours (GDH) built up during plant cultivation, the top flower height and the plant structure are very useful in this respect. One uncertain factor in planning the harvest well in advance is the weather conditions after planting. The best possible harvest forecast can be achieved by using multiannual average day temperatures, calculated from the planting date of the production field.

From flowering induction to harvest

Using the growing degree hours formula can be very helpful in making the most accurate cultivation, labour and harvest planning possible. Broadly speaking, we can say that for an everbearing crop, a minimum of 25,000 growing degree hours (GDH) can be expected. The counting starts from the moment of flowering induction and continues until the harvest of the first ripe fruits.

The flowering induction usually does not start immediately after cutting or planting. Once cuttings are planted the induction will start quickly, after transplanting a plant that has a history of a number of cold hours, the start of flowering induction may take up to 3 to 6 weeks, depending on the variety.

Counting from the planting date of a refrigerated plant, Favori will reach around 31,000 GDH for the flowers induced after planting, while Florentina and Florina will start fruit production after around 28,000 GDH with the flowers formed after planting. Florentina and Florina have a relatively short period during which they are not receptive to flower formation.

The GDH requirement is different for each variety and can only be determined based on cultivation experience. The calculated GDHs required are only an indication, usually with a margin of +10 to - 10%, as GDHs are partly influenced by other growing conditions than air temperature alone. Ground temperature, day length and stress factors also play a role.

In fact, the number of GDHs required applies to each flower that is formed. The desired GDHs are reached earlier at high temperatures than at low temperatures.

> *To calculate the number of GDHs, start from the date that the flowering induction started. This date can be determined afterwards after a first flower bud examination. The best time for a flower bud examination depends on when the plants were cut or planted. From the start of the flowering induction, calculate the average temperature per hour, minus 4.5. The resulting number is the number of GDH of an hour.*
>
> *For example, the average temperature on April 20 between 8.00 and 9.00 was 11°C. The number of GDHs built up during this hour is then 11 - 4.5 = 6.5 GDH.*

We know from experience that a fruit of the Favori variety requires a total of 27,000 GDH under good growing conditions, from flowering induction to harvest *(Source: Van der Avoird Trayplant)*. Also, in the case of Favori, with a margin of +10 to -10%.

Divided into cultivation phases at Favori, 12,500 of these GDHs are required from flowering induction to a top flower height of 8-10 mm. Approximately 7,000 GDH are required from this top flower height to flowering. From the first flowering to the first ripe fruit, it takes approximately 7,500 GDH. Other varieties may require as many as 10,000 GDH in this final phase.

Flower induction will never happen exactly at the same time with everbearers, even within the same batch of plant material. The age (generation) of the cutting material plays a role in this. By using cuttings from the same generation, the flowering induction will happen more evenly than with plant material for which different generations of cuttings have been used interchangeably. The same irregularity in flowering induction also occurs when frigo plants are used in a propagation field of which several generations usually end up in the same crate of plant material.

If a farm keeps good records and flower bud research data is available, it can be determined how much GDHs are required up to the first harvest or up to a possible next major harvest peak. Cultivation and harvest planning can become increasingly accurate based on many years of experience with this.

Picture 4: strawberry plant with 2 crowns, a good start for an everbearer

4. Nutrition and watering for substrate crops

NovaCropControl carried out further research into the desired nutritional level for the everbearing varieties Furore and Favori. For other varieties, the desired nutritional levels may differ slightly from the recommendations below. Broadly speaking, most other everbearing varieties can be grown based on these guidelines.

The advice below is indicative and should always be discussed with your crop adviser. Farm-specific circumstances, such as water quality and the state of the crop, may lead to different choices in fertilization advice.

Water and nutrition in general

Starting with a dripping EC of 1.3-1.4 after planting is sufficient for Furore and Favori. Higher dripping ECs are often not necessary because this can lead to rapidly increasing draining ECs early in the cultivation, resulting in salinisation of the substrate and faster wear of the crop. Aiming for a drip and draining EC sum of 2.5 is generally sufficient. Please note these remarks, however:

- When using spring water with a certain EC, a correction must be made for this according to the fertilization recipe. In addition, lowering the dripping EC increases the influence of the spring water on the composition of the nutrient solution, especially if it contains sodium, chloride or boron, for example. Therefore, always check the composition of the outlet water.

- The drop of EC should not be lowered indefinitely in case of an increasing draining EC. The draining EC often rises more easily in the second half of the crop. Lowering the dripping EC too much can then lead to an insufficient amount of nutrition (especially too low nitrate). Therefore, maintain a certain minimum dripping EC.

Schedules with more than 5.0 mmol/litre potassium as used for June-bearers are not required for Furore and Favori. In a stage with a very high plant load, the potassium-calcium ratio can be increased to 1.2-1.3 to administer a little more potassium relative to calcium. Use this method in moderation, because high potassium has an inhibitory effect on growth.

The trace element content for Furore and Favori is largely the same as for other varieties, but be careful with too much manganese and boron in the nutrient solution. Certainly, with a lot of watering, these can quickly become too high in the plant, as a result of which excess phenomena such as leaf burning and faster wear of the crop may occur. In case of warm weather and a lot of watering, 8-10 µmol boron and 10-12 µmol manganese are sufficient.

Regularly monitor the nutritional status of the crop using water and leaf analyses and adjust the composition of the nutrient solution accordingly.

Points for attention Furore

From the moment of planting until the first fruiting, a potassium-calcium ratio of approximately 0.75 in the nutrient solution will suffice to get enough calcium into the crop at the start.

Furore absorbs calcium very easily. This means that a magnesium deficiency can occur more quickly compared to other varieties. Therefore, start with 1.5 mmol/litre magnesium and maintain 1.0-1,2 mmol/litre during production. Make sure that it does not get too low when the dripping EC is lowered.

Standard nutrient solution Furore from plants to fruiting:

mS/cm		mmol/litre								µmol/litre					
EC	K	Ca	K/Ca	Mg	NH4	NO3	Cl	S	P	Fe	Mn	Zn	B	Cu	Mo
1.4	3.00	4.00	0.75	1.50	0.00	10.00	0.00	1.60	0.80	50	20	12	15	1.25	1.00

When the first fruits start to appear, more potassium is needed. The potassium-calcium ratio in the nutrient solution must now be reduced to 1.0.

Standard nutrient solution Furore from fruiting and during production:

mS/cm		mmol/litre								µmol/litre					
EC	K	Ca	K/Ca	Mg	NH4	NO3	Cl	S	P	Fe	Mn	Zn	B	Cu	Mo
1.4	3.70	3.70	1.00	1.20	0.50	10.00	0.00	1.60	0.80	40	10	10	10	1.25	1.00

Furore is often more generative than other everbearers and not likely to become too vegetative. Ammonium can be used to ensure that the crop continues to make sufficient new leaf positions and crowns.

Use ammonium within a range of 0.25-1.0 mmol/litre. At higher dosages, the pH of the substrate and the drain water can become too low, causing damage to the roots. Determine the amount of ammonium based on the crop position, flower research and the weather conditions. Discuss this with your crop adviser.

Example of nutrition tanks for Furore

The fertilizer tanks are 100x concentrated and calculated for an EC of 1.4. This is based on rainwater. When using spring water or surface water, the necessary corrections should be made based on the composition of this outlet water.

From planting to fruiting

A-tank1000 litres	B-tank 1000 litres
86.4 kg Calcium nitrate	10.9 kg Monopotassium phosphate
	36,9 kg Magnesium sulphate
4.7 kg Fe-DTPA 6%	1.7 kg Potassium sulphate
	20.2 kg Potassium nitrate
	340 grams Manganese sulphate 32.5%
	345 grams Zinc sulphate 23%
	145 grams Borax
	31 grams Copper sulphate 25%
	24 grams Sodium molybdate 40%

From fruiting and during production

A-tank 1000 litres	B-tank 1000 litres
79.9 kg Calcium nitrate	10.9 kg Monopotassium phosphate
	29,5 kg Magnesium sulphate
3.7 kg Fe-DTPA 6%	7.0 kg Potassium sulphate
	21.2 kg Potassium nitrate
	170 grams Manganese sulphate 32.5%
	290 grams Zinc sulphate 23%
	95 grams Borax
	31 grams Copper sulphate 25%
	24 grams Sodium molybdate 40%

Points for attention Favori

For Favori, it is important to use additional calcium in the fertilization schedule at the start of the cultivation relative to potassium and magnesium. There is a greater need for calcium, because Favori absorbs magnesium of its own accord more easily.

In addition, potassium can also be calculated somewhat lower relative to calcium. A potassium-calcium ratio of approximately 0.6-0.7 is sufficient.

Standard nutrient solution Favori from planting to fruiting:

mS/cm		mmol/litre								µmol/litre					
EC	K	Ca	K/Ca	Mg	NH4	NO3	Cl	S	P	Fe	Mn	Zn	B	Cu	Mo
1.4	2.80	4.50	0.65	1.10	0.00	10.00	0.00	1.60	0.80	50	20	12	15	1.25	1.00

From the moment the first set fruits start to develop, potassium should be increased. The potassium-calcium ratio must then be increased to 1.0.

Standard nutrient solution Favori from fruiting and during production:

mS/cm		mmol/litre								µmol/litre					
EC	K	Ca	K/Ca	Mg	NH4	NO3	Cl	S	P	Fe	Mn	Zn	B	Cu	Mo
1.4	4.00	4.00	1.00	1.00	0.00	10.00	0.00	1.60	0.80	40	10	10	10	1.25	1.00

Favori has a tendency to delay the formation of flower trusses when too much nitrogen is supplied. This can create a larger production gap. That is why standard use of ammonium is not necessary with Favori. The use of ammonium is necessary, however, if it appears that the crop forms insufficient new leaf positions or crowns.

To further limit the nitrogen supply, part of the nitrate dose can be replaced by chloride. It is possible to give up to 1 mmol/litre of chloride in the form of calcium chloride. Experience with higher chloride levels is still limited.

Make sure that chloride does not displace too much nitrate nitrogen in the plant when the crop becomes more generative. Sufficient nitrogen will then be required again. Determine whether the use of ammonium or chloride is necessary based on the crop position, flower research and the weather conditions. Regular plant sap analyses are recommended to be able to adjust the nutrition in good time.

Example of nutrition tank contents for Favori

The nutrition tanks are 100x concentrated and calculated for an EC of 1.4. This is based on rainwater. When using spring water or surface water, the necessary corrections should be made based on the composition of this outlet water.

From planting to fruiting

A-tank 1000 litres	B-tank1000 litres
97.2 kg Calcium nitrate	10.9 kg Monopotassium phosphate
	27,1 kg Magnesium sulphate
4.7 kg Fe-DTPA 6%	8.7 kg Potassium sulphate
	10.1 kg Potassium nitrate
	340 grams Manganese sulphate 32.5%
	345 grams Zinc sulphate 23%
	145 grams Borax
	31 grams Copper sulphate 25%
	24 grams Sodium molybdate 40%

From fruiting and during production

A-tank 1000 litres	B-tank 1000 litres
86.4 kg Calcium nitrate	10.9 kg Monopotassium phosphate
	24,6 kg Magnesium sulphate
3.7 kg Fe-DTPA 6%	10.4 kg Potassium sulphate
	20.2 kg Potassium nitrate
	170 grams Manganese sulphate 32.5%
	290 grams Zinc sulphate 23%
	95 grams Borax
	31 grams Copper sulphate 25%
	24 grams Sodium molybdate 40%

5. Tip burn, seediness and kinking trusses

and the relationship with

water, nutrition, plant load and climate

Tip burn, seediness and kinking trusses are physiological symptoms, as a direct result of water and nutritional stress at a certain time. The degree of often rapidly changing plant load and climate conditions influence this effect.

The sensitivity to, or the degree to which these physiological symptoms manifest themselves, is partly genetic and therefore variety-dependent.

5.1 Causes of water / nutritional stress (sometimes several simultaneously)

1. Too little irrigation so that the sap flow is not maintained and nutrition does not end up in the right places in the plant (negative pressure).
   - Too few waterings
   - Waterings are too far apart
   - There seems to be enough drain, but due to irrigation at the wrong time it can produce a wrong picture.

2. Watering too high, which can cause roots to die. During the day, perhaps not too much water is given, but if the last waterings are given too late in the day, the substrate may remain too wet throughout the night. As a result, roots die and the absorption capacity enters a negative spiral. As a result, the pH of the substrate can also crash, reducing absorption of the main elements (negative pressure).

3. A high salt concentration in the substrate and an excessively high dripping EC limit the absorption capacity of water (negative pressure is lurking, but overpressure is less likely).

4. The ratio between the elements in the substrate can be overly unbalanced, causing antagonism between the elements. As a result, some elements will not achieve their goal.

5. A K:Ca ratio that is too low or too high. Every phase in the cultivation has its optimum. In everbearers, all phases occur simultaneously, so that nutrition is often a compromise between stimulating vegetative growth and generative growth. However, the plant does not always have the same needs.

6. The substrate has often cooled down considerably in the morning. If the evaporation of the crop then increases sharply due to the sun suddenly coming out and/or increasing wind, the sap flow cannot keep up with this quickly enough due to the low root temperature (negative pressure).

7. Rapid cooling of the surroundings while the substrate temperature is still relatively warm and the roots supply more than the plant needs to grow and evaporate (overpressure)

8. A rapid decrease in plant load, where the root system is still set to growing many fruits at once. A similar situation can occur in case of rigorous leaf picking (overpressure).

9. A strongly increasing moisture deficit in the air around the plants. The evaporation can then be higher than the water absorption by the plants. Especially in combination with higher plant temperatures, the plant will close its stomata. This results in obstruction of the CO2 absorption and the plant ends up in a stress situation (negative pressure).

5.2 Consequences of water / nutritional stress

Tip burn occurs after all causes involving overpressure (causes 7 and 8)

- Tip burn can also easily occur after periodic negative pressure in the plant when this periodic negative pressure is followed by overpressure. Due to negative pressure, calcium in particular cannot reach its destination in the growth points, which creates a shortage of the important building block for strong cell walls. Calcium is a non-mobile element which can only be transported with an active juice flow. Tip burn often occurs first shortly after planting, if root development has not yet started sufficiently.

  To prevent tip burn, the windows in the greenhouse, or the tunnel are often kept closed during the evening to increase the RH and thus limit evaporation. The goal is to thereby stimulate calcium transport to the growth points, but this can be counterproductive if the calcium transport has previously been impeded and weak cells have been formed.

  When the ambient temperature drops rapidly at the end of the day while the substrate is still relatively warm, there is usually still sufficient root pressure and it is therefore preferable not to close the greenhouse or tunnels.

Kinking trusses occur in all cases where negative pressure in the plant occurs, as a result of a usually short-term limited supply of water with nutrition (causes 1, 2, 3, 6 and 9)

Seediness is thought to be a result of cell depletion, due to incorrect nutritional ratios (causes 4 and 5). Negative pressure due to possible causes 1, 2, 3, 6 and 9 amplifies this problem.

When there is a shortage of nutrition and/or water in the young parts of the plant, the plant draws water and nutrition from the oldest leaves, but also from the receptacles and fruits that are developing. This can cause fruits to become seedy.

Seedy fruits are often firm, because calcium is not mobile once it is fixed in the cell walls of the fruits. However, lack of potassium, which normally keeps cells tense, can lead to deflating cells in the fruits and ovaries. This causes the flesh to shrink and the seeds to lie higher.

5.3 Prevention of water / nutritional stress

1. Check substrate humidity and adjust the frequency and size of waterings accordingly, for an optimal water supply. Control irrigation via radiation sum or growth scale. Even a brief moment of negative pressure in the plant can lead to kinking trusses.

2. Do not allow drainage percentages to diverge too far from the desired direction.

	First week	Growth phase	Flowering phase	Harvest phase
An active crop	moist	10-15%	15-25%	25-30%
A not very active crop	moist	5-10%	10-15%	10-20%

3. On hot days, when a lot of water needs to be given, a varying EC level of the dripping water is preferable. In order not to allow the EC of the substrate rise too much, a time block can be built in for the afternoon hours in which dripping with a low EC takes place. In the morning and at the end of the day, a higher EC can then be added (perhaps slightly higher than the recommended EC in the fertilization schedule). In this way, you can provide the necessary nutrition at times when the plants need it most and flush out excess salts during the warm afternoon.

   For example, a schedule in which on a sunny warm day dripping session with an EC of 1.5 are given until 11.00 a.m., then until 15.00 p.m. followed by waterings with an EC of 0.9 and the rest of the day with a dripping EC of 1.5.

4. It is recommended to have biweekly plant sap analyses of young and old leaves, supplemented with dripping water and drain water analyses, in order to be able to make fertilization schedules that are as perfect as possible.

5. Seediness is a recurring problem, especially in many everbearing varieties. Since, in fact, everbearers always undergo vegetative and generative development simultaneously, the fertilization schedule is a compromise. In particular, the K/Ca is usually around 4:4. This ratio is based on a crop with a good balance between vegetative and generative development. In practice, however, that balance is not always optimal.

   However, trials by Philip Lieten and Nicole Gallace (PC Fruit, Sint-Truiden, Belgium) have shown that a higher K/Ca ratio results in less seedy fruits. Fruit firmness, shelf life and colour would also be positively influenced by a higher K/Ca ratio.

   As a deviation from the standard K/Ca ratio 4:4, the following strategy can be considered for everbearers, especially when a very large harvest peak is expected:

   - From planting to full flowering of the first flush K/Ca 4:4
   - From full flowering until 80% of the first flush is harvested K/Ca 7:3
   - Follow-up from 80% harvested from the first flush to the end of cultivation:
     - As a basis, K/Ca 5:3 with sufficient vegetative growth or 4:4 when more vegetative growth is desired.
     - If during the course of the season another huge flush appears to be on its way, maintain a 7:3 ratio from full flowering.

6. During the day, the substrate often heats up quickly. As a result, roots become more active and root pressure increases. When at the end of the day the ambient temperature drops rapidly (is lowered), the evaporation by the plants decreases, but due to the heated substrate, the root pressure is still considerable. As a result, the sap flow squeezes out through the growing points and tip burn is inevitable. Even when there is enough calcium in the growth points.

   One suggestion is to let the temperature drop more gradually at the end of the day, if possible, so that evaporation and root pressure can become better aligned. Creating air movement also has a positive effect in gradually balancing evaporation and root pressure. For everbearers in greenhouses, a higher minimum night temperature may also be part of the solution, for example 12°C instead of 8°C.

7. Depending on the plant load, it may be necessary to build up extra root pressure at the end of the day, or indeed limit it.

   <u>Building up root pressure</u>

   When a major harvest flush is expected, the plant load gradually increases. To ensure that fruits can grow optimally, sufficient root pressure is needed to get enough nutrition and water into the fruits. If the root pressure is insufficient, a partially reversed sap flow may occur, causing cells in the fruit to be sucked empty in favour of other plant parts.

   With a relatively low EC, plants can absorb water more easily and as a result create root pressure more easily. Particularly at higher temperatures, a lower dripping EC is recommended, because then, due to the large number of dripping sessions, it still provides sufficient nutrition in absolute terms.

   To build up additional root pressure, watering should not be discontinued too early at the end of the day. In addition, greenhouses or high foil tunnels can be completely closed for several hours in the early evening to limit evaporation, which also builds up root pressure.

   In any case, the evaporation must be prevented from exceeding what the plant can absorb from the substrate water. Additional auxiliary measures include moistening the grass under the table tops, fine misting and/or roof irrigation.

   <u>Reducing root pressure</u>

   When a major harvest flush is past its peak, the plant load decreases and it becomes easier for the plant to send water and nutrition to the fruits, leaves and young plant parts.

   At a certain point in time, the root pressure can become higher than what the rest of the plant parts need. This results in overpressure: the plant squeezes the water through the weakest cells, i.e. through the youngest parts of the plant to the outside, and tip burn is inevitable.

   In this situation, with a decreasing plant load, it is advisable to stop watering earlier in the day. In this case, it is also better to leave tunnels and greenhouses open during the evening hours to keep evaporation going. Thorough ventilation helps to reduce root pressure.

6. Nutrition and watering for open-ground crops

As with any substrate cultivation, a balanced growth and plant load are also desirable for open-ground cultivation of everbearers. Nutrition and watering also play an important role in this regard.

Soil

Everbearers thrive best in fertile, healthy soil on which the plant can grow as undisturbed as possible. The optimum pH of the soils is between 5.5 and 6.0 maximum. The water used for irrigation should have a similar pH. If the pH is too high, problems may arise with the absorption of trace elements. With a very low pH, the main elements such as Ca, K and Mg are not absorbed as well.

Before planting, the soil stock of all elements must be brought to a good base level.

Basic nutrition and additional fertilization

After planting, you can start administering the basic nutrition so that the plants can start quickly. Since most everbearers are grown in the open ground on narrow, foil-covered soil ridges, watering and nutrition takes place via T-Tape or another type of inline dripping system.

A start fertilization could be a starting dose with MAP (monoammonium phosphate) to stimulate root formation, followed by alternating weekly small doses of calcium nitrate and magnesium sulphate. From the first harvest, potassium nitrate can be used instead of calcium nitrate, alternating with potassium sulphate if the crop becomes too vegetative, or to obtain firmer fruits.

The quantities of fertilizers used are best decided in consultation with a crop adviser. They depend on the soil stock and the crop requirements. Regular plant sap analysis is an excellent tool to identify crop needs.

Measuring is knowing!

Picture 5: Everbearers on ridges

7. Integrated crop protection and pollination

7.1 Insects

Everbearing varieties usually grow and flower over a longer period than June-bearing varieties. As a result, there will always be disease incidence from insects such as spider mites and thrips. This need not be a problem as long as the use of natural enemies is started in time. The advantage of a long cultivation is that natural enemies can build up a large population, thereby keeping the pests largely under control.

In open-ground crops without a tunnel cover, releasing natural enemies is not very useful. Nevertheless, natural enemies can also make a significant contribution in open-ground cultivation. Predatory bugs, parasitic wasps and hoverflies are naturally common.

Some predatory bug species may also damage open flowers. When bugs pierce the receptacle, fruit growth is deformed. There are no known natural enemies that can be used against this.

Photo 7: adult harmful bug

Picture 6: nymph of a harmful bug

Picture 8: Garlic between everbearers, planted to prevent thrips

7.2 Powdery mildew

Flevo Berry's everbearing varieties are relatively strong against powdery mildew under normal growing conditions. Nevertheless, preventive measures are recommended and timely action after observation is necessary.

7.3 Pollination

Everbearing strawberries flower for a long time, but also in flowering peaks and dips. Sometimes there are many flowers, followed by only a few. Overvisiting sometimes occurs in greenhouses and tunnels when bumblebees are deployed. In that case, the bumblebees damage the receptacles and the fruits become deformed. It is important to always strike a good balance between the number of bumblebees and the amount of flowers. Sometimes, bumblebee colonies will have to be temporarily closed, or new colonies will have to be added in case of lots of flowering.

When bees are deployed, overvisiting is not a problem. However, bees like good weather and take a day off every now and then in overcast weather. A combination of bees and a limited number of bumblebees is therefore recommended, to always have enough pollinating insects at work.

For outdoor crops, pollination by wind and naturally occurring insects is usually sufficient.

Picture 9: pollinator at work

8. Crop maintenance

A good plant balance not only depends on a good growing climate, good nutrition and watering. Physical maintenance of the plant can also make a significant contribution. Attention must be focused in particular on a good balance between vegetative and generative growth.

8.1 Leaf picking

Old, worn leaves are best removed in any case. They contribute little, or nothing, to photosynthesis. In addition, old leaves block some of the light for young leaves and emerging new flower trusses.

Regularly removing older leaves is preferable to doing rigorous pruning only now and then. Doing this keeps the rejuvenation of leaves going and prevents plants from ending up with relatively little leaf surface after leaf picking.

Excessive leaf picking may also stimulate tip burn, when evaporation and root pressure become unbalanced. If the plants have sufficient leaves, you can safely remove a leaf here and there that covers the fruit trusses.

8.2 Removing flower trusses

With everbearing varieties, the very first flower trusses are often removed. Particularly in open-ground crops where a plant is started with a frigo A plant, this is done to first allow the plant to grow more vegetatively and to develop side crowns. The harvest may start a little later in that case, but the production and the quality of the fruits will increase significantly.

In substrate crops, the first trusses are usually left, partly to stimulate a good balance between generative and vegetative development. In addition to being able to harvest earlier, the first flush of fruits, particularly from the tray plants, mini tray plants and plug plants, are of excellent quality, provided the crop is sufficiently vegetative.

8.3 Removing runners

It is advisable to regularly remove runners. Sugars are also transported to the runners. It is better if these sugars go to the fruits and to the new leaves and truss formation.

Runners are also troublesome during picking, especially if they grow too long.

8.4 Removing worn-out trusses

After several harvest months, there may be many remnants of fruit trusses on the plant. In general, these don't cause any major problems, other than looking a little messy. On a very rare occasion fruit can be damaged when it is touched by the dry and hardened old truss stems. Plant growth and health do not suffer from these worn-out trusses.

Picture 10: Removing the first flower trusses from Florentina

9. Cultivation strategies for everbearers

If different cultivation strategies systems are used, it is possible to harvest fruits year-round. We have worked out nine possible strategies.

1. Late cultivation after early cultivation of June-bearers, planting date late in April and harvest from late June to the end of the year.

2. Double cropping in a regularly heated greenhouse, planting date mid-July, harvest from early September to December, limited cold in winter and a second harvest from early April to mid-June.

3. Cultivation in a cold greenhouse, with some gentle heating if necessary, planting date in mid-February and harvest from early May until late November.

4. Tunnel cultivation on soil ridges or in a Hochstädter Damm, planting date late August and harvest from early May to mid-June for the first large flush. Then, depending on the condition of the crop, harvesting can continue for longer.

5. Tunnel cultivation (high tunnels) on table tops or in a Hochstädter Damm, with planting date late February and harvest from mid-May to mid-October.

6. Late cultivation in high tunnels on table tops or in a Hochstädter Damm, after harvest of an early variety, with a cultivation start in a tunnel from late April, transferred to the production tunnel around mid-June and harvest from late June to mid-October.

7. Cultivation on table tops (small tunnels) with planting date early March and harvest from late May until late September.

8. Illuminated winter cultivation, planting date mid-August and harvest from mid-October to mid-April.

9. Summer cultivation on soil ridges with black foil, possibly temporarily covered with tunnels, with harvest from early July to late September.

General information regarding cultivation strategies:

- In a relatively long-term substrate cultivation (6-7 months), usually 6 to 7 plants are planted per linear metre, regardless of the plant variety. A higher plant number is possible, even up to 10 plants per linear metre. A higher plant density can be chosen if the goal is to achieve the largest possible first harvest flush. After the first harvest flush, this high plant density is sometimes reduced to 6-7 plants per linear metre. Calculated for the entire season, at a higher plant density, production per plant will probably be at a lower level than if 6 plants had been planted per linear metre.

- When an everbearing variety is planted for a relatively short cultivation period (for example, 4 months), increasing the number of plants per linear metre can ensure that a sufficiently large yield per m2 is achieved. Around 8 to a maximum of 10 plants per linear metre are then recommended, with a preference for mini-tray plants or tray plants due to the high yield potential in the short term.

- In open-ground cultivation, 4 to 5 plants are usually planted per linear metre. The row distance is usually 1 metre.

- Everbearers are almost always planted in a single-row system, both on substrate and in the open ground.

- Irrigation and feeding follow according to the starting schedule, followed by the flowering/harvest schedule.

- We know that plant material from June-bearers originating from the freezer is not receptive to flower formation for a certain period immediately after planting. Variety-specific periods of postponement of flower formation also occur with cooled plant material from everbearers. We know that for Florentina and Florina, this period lasts around 3 weeks and for Favori it takes around 5 weeks. The Florin variety is not receptive to flower formation for 6 weeks.

- The different strategies on the following pages are based on 5 weeks of non-receptiveness to flower formation, after planting cooled material. Depending on the variety used, a recalculation can be made if necessary.

- If the cultivation starts in a warm period or environment, the period of non-receptiveness will probably be slightly shorter. Flower bud research can provide clarity about the actual start date of flower formation.

- In addition to the period of non-receptiveness to flower formation as a result of accumulated chilling hours, the plant load as a result of many flowers and fruits can also put the brakes on the development of new flower buds.

- The period from the start of flower formation to harvest depends on the speed at which the number of required growing degree hours (GDH) builds up, and therefore depends on temperature. All expectations regarding harvest dates mentioned below are therefore indicative.

9.1 Late cultivation after early greenhouse cultivation of June-bearers

Recommended varieties: Favori and Bravura

Recommended plant material: the choice is between tray plants wintered in the greenhouse or for cooled plant material (tray plants, mini-tray plants, plug plant or frigo A /A +)

Harvest period: from late May to November

J	F	M	A	M	J	J	A	S	O	N	D

After an early, heated spring crop with a June-bearing variety, the cultivation gutters are free again to start a new crop from the end of April at the latest. There are several options for performing this cultivation with everbearing varieties.

Cultivation methods and harvest progress

Option 1: at the end of March, wintered, slightly heated and illuminated tray plants are planted in cultivation troughs, for a successful growth start in a temporarily greenhouse. The trusses of winter flowers are removed at the same time as planting.

The new flower formation is already formed and at the end of April, when the plants are placed in the production greenhouse, there is already a plant with flower buds that have formed in spring. Chances are the strawberry plants will have already started flowering.

The first large flush of strawberries can be expected from the end of May, while flower bud formation continues. There may be a dip in production due to an excessive plant load as a result of the first harvest flush.

Option 2: at the end of March, wintered, kept cold and unlit tray plants are planted in cultivation troughs for a successful growth start in a temporarily greenhouse. The winter flowers are not removed.

These plants will flower from the end of March and the winter flowers will have already started to bear fruit by early May, although the quality may not be ideal.

Flower bud formation in the plant material has already started to a limited extent, but it will only really start to take off from mid-April (> 14 hours day length). By not removing the winter flowers, the plant load stays reasonably balanced.

Once the cultivation gutters in the production greenhouse are free again, the cultivation troughs can be moved there.

From the beginning of June, the first flush of fruits that were formed in the spring starts. Due to a controlled plant load, production should be able to run relatively evenly.

Option 3: at the end of March, cooled tray plants, mini tray plants, plug plants, A+ or frigo A plants are planted in the cultivation troughs and placed in a temporarily greenhouse.

When the cultivation troughs are placed in the cultivation gutter at the end of April, the first winter flowers will be open.

Photo 11: everbearers on table tops

The formation of new flower buds only starts when the plants are receptive to flower bud formation. Any cold that the plants have suffered after planting may cause a delay. If this delay (non-receptiveness) lasts for 5 weeks, the plants would not start to form flower buds again until early May.

The harvest of the first flush of these plants will start in early June. Production will drop temporarily from the end of June and will not increase again until mid-July.

Option 4: at the end of April, cooled tray plants, mini tray plants, plug plants, A+ or frigo A plants are planted in the cultivation troughs, directly in the gutter in the production greenhouse.

Harvest of the first flush of these plants will start in late June. Production will drop temporarily around mid-July and will increase again late July, because flower formation has only started again at the beginning of June (after a period of non-receptiveness for flower formation).

9.2 Double cropping in a regularly heated greenhouse

Recommended varieties: Favori, Furore, Bravura, Altess

Recommended plant material: choosing cooled tray plants or mini tray plants is preferable. An early and freshly cut mini tray plant is also an option.

Harvest period: first harvest from September to December, second harvest from April to June

J	F	M	A	M	J	J	A	S	O	N	D

Double cropping with an everbearing variety is not yet common practice. Nevertheless, good results have been achieved and this cultivation method offers perspectives. Planting in the summer should preferably happen a little earlier than the regular cultivation with June-bearers, otherwise the production level in autumn will insufficient.

Usually, the greenhouses intended for double cropping are empty during the month of July, so earlier planting is normally not an issue. We strongly recommend cooling the crop by misting and/or roof irrigation for a sufficient vegetative start of the cultivation.

Cultivation method and harvest progress

In a planting period that is usually burdened by relatively high temperatures, refrigerated mini-tray or tray plants are preferred because of their vigorous start. A fresh tray plant is a possible alternative, which can be cut around the beginning of June of the same year.

The planting time for fresh tray plants is around mid-July, possibly earlier if the plants are ready to plant. If cooled plants are used, it is recommended to plant in the open air in the troughs from early June, when these plants still have enough time to create new trusses. They are then placed in the greenhouse in July.

Although the day length will be getting shorter than 14 hours from August 25th, a day extension with lights is not necessary after that. After all, in the greenhouse it takes around 100 days from this date from flowering induction to harvest. The fruits planted at the end of August can therefore only be harvested from late November until early December.

The harvest of all plant types will start from the beginning of September. With refrigerated plants, a higher production can be achieved in September, less in October and perhaps more again in November. With a fresh tray plant, the autumn production will mainly be harvested in October and November. Spring production is expected to be similar for both plant types.

The harvest will gradually decrease from mid-November due to lower solar radiation, after which the temperature will be kept at a minimum of 7 degrees from Christmas to quickly restart flower formation in the spring (excessive cold inhibits flower formation).

At the end of January, the heating can be slowly turned on again, as with a regular crop of June bearers. The plants can then be cleaned up, whereby the number of rhizomes per plant is also limited to 3 in order to avoid an overly bushy plant shape.

The cyclical lighting can also be switched on again from the end of January, to create a day length of 14 hours. To be able to pick plenty of strawberries in June and possibly even longer, keeping the cyclical lighting on until mid-April is recommended. Around mid-April, the natural day length takes over from artificial light.

The spring harvest will start from mid-April and can continue until the late June or longer, depending on possible late cultivation.

Picture 12: Favori on table tops

9.3 Cultivation in a cold greenhouse with possibly light heating

Recommended varieties: Favori, Bravura, Florentina, Florina

Recommended plant material: choose from tray plants that have wintered in the greenhouse, or cooled tray plants, mini tray plants, plug plants, A+ or frigo A

Harvest period: from late April to November

J	F	M	A	M	J	J	A	S	O	N	D

This cultivation method is ideally suited for a greenhouse where little or no heating is possible.

Cultivation methods and production progress

Option 1: around mid-February, wintered tray plants are planted, with flower bud formation actively stimulated by maintaining a minimum temperature of 9°C in the propagation greenhouse from the beginning of January, combined with cyclical lighting to give the plants the feeling of a day length of at least 14 hours.

If the winter flowers have not been removed, the first flush of fruits will start around the end of April. Due to a controlled plant load and the stimulation of flower formation with cyclical lighting from the planting date, production should then be able to proceed relatively evenly.

If the winter flowers are removed, the first flush of fruits is well under way by mid-May. Stimulating flower formation from the planting date with cyclical lighting, during a period with low plant load, can result in a production pattern with more ups and downs than the alternative with non-removed winter flowers.

Option 2: wintered tray plants are planted around mid-February; here early flower bud formation is not additionally stimulated. After planting, the greenhouse is kept relatively cold, but preferably not below 9°C with no additional growing light. preferably the winter flowers are not removed because the plant balance could be disturbed from mid-April (long day > 14 hours) due to excessive flower formation.

Flower bud are forming to a limited extent when planting out in the greenhouse. This will accelerate from mid-April onward (14+ hours day length), but by not removing the winter flowers, the plant load stays reasonably balanced. Cyclic lighting can be an option from early March to mid-April to encourage earlier flower bud formation.

These plants will flower from early April and the winter flowers will have already started to bear fruit by early May, although the quality of the first fruits may not be ideal.

From the beginning of June, the first flush of fruits that were formed in the spring is well under way. Due to a controlled plant load, production should be evenly spread.

Option 3: cooled tray plants, mini tray plants, A+ or A frigo plants are planted mid-February.

The first winter flowers will open in early April, after which the first flush of fruits can be picked from early May.

The formation of new flower buds only starts when the plants are receptive to flower bud formation. The cold that the plants have experienced causes delay in receptiveness. If this delay lasts 5 weeks, the plants would not be able to produce flower buds again until late March. Partly due to the plant load caused by the first flush, the formation of flower buds will be on the back burner until mid-April. Cyclic lighting may be an option from mid-March to mid-April.

The harvest of the first flush will drop off temporarily from late May. Production will start to increase again around mid-June because flower formation only started again at the end of March.

Picture 13: Favori on table tops

9.4 Wintering tunnel cultivation in soil ridges or in a Hochstädter Damm

Recommended varieties: Favori, Furore, Bravura, Altess, Florentina and Hademar

Recommended planting material: fresh green plants or fresh plug plants are best suited for this growing method. Plug plants are preferred because of a successful start and undisturbed flower bud formation.

Harvest period: from early May to mid-June, possibly longer.

J	F	M	A	M	J	J	A	S	O	N	D

This cultivation method is a relatively simple and inexpensive way to cultivate everbearers. Getting these plants through the winter is essential and may take some interventions, the reward for this effort is a potentially highly lucrative crop.

Cultivation method and harvest progress

The optimal planting time is around 20 August, when the plants still have plenty of time to form several crowns and establish enough flower buds for the following spring.

During September and early October, the runners must be removed regularly. Until spring, keep foil or horticultural fleece on hand to cover the plants during periods of frost.

The plants will flower from early April, after which the harvest will start around 1 May. If the plants have grown well in autumn and have created multiple side crowns, the first flush will be huge.

The first big flush is over at the beginning of June. After that, there is a choice to leave the crop or to end the cultivation. The production of the flowers created in spring will not start again until July.

Picture 14: Organic cultivation of Altess in the open ground

9.5 Tunnel cultivation (high) on table tops or in Hochstädter Damm

Recommended varieties: Favori Furore Bravura Altess, Hademar, Florentina and Florina

Recommended plant material: Cooled tray plants, mini tray plants, plug plants, A+ and frigo A are suitable for this cultivation method.

Harvesting period: from mid-May to mid-October

J	F	M	A	M	J	J	A	S	O	N	D

As soon as the risk of severe frost has mostly passed, this cultivation can be started, provided the substrate temperature is not < 8°C. The entire tunnel season can be completed with a single crop. The total yield is usually at the level of two consecutive crops with June-bearing varieties. With an everbearing variety, however, the harvest and labour are more spread out over the season than with two separate crops.

Cultivation method and harvest progress

If the weather permits, refrigerated tray plants, mini tray plants, plug plants, A+ or A plants can be planted at the end of February.

The first winter flowers will open in April, after which the first flush of fruits can be picked from mid-May.

The formation of new flower buds only starts when the plants are receptive to flower bud formation. The cold that the plants have had causes delay. If this delay lasts 5 weeks, the plants would not be able to produce flower buds again until early April. Due to plant load caused by the first flush, the formation of flower buds will be on the back burner until late April.

The harvest of the first flush will drop off temporarily from mid-June. Production will start to increase again from early July because flower formation only started again at the beginning of April, after a period of not being receptive to flower formation.

Picture 15: Everbearer in high tunnel on table tops

9.6 Late cultivation in high tunnels on table tops or in a Hochstädter Damm

Recommended varieties: Favori Furore Bravura Altess, Hademar, Florentina and Florina

Recommended plant material: Cooled tray plants, mini tray plants, plug plants, A+ and A are suitable for this cultivation method.

Harvest period: from late June to mid-October

J	F	M	A	M	J	J	A	S	O	N	D

After the harvest of an early June-bearer, another June-bearer can be grown. A good alternative for late cultivation can be cultivation with an everbearing variety. A condition for success is that the plants have previously been forced in a tunnel. Without forcing the plants before transferring them to the production tunnel, the harvest period will be shorter, which will of course be at the expense of the total production.

Cultivation method and harvest progress

At the end of April, cooled tray plants, mini tray plants, plug plants, A+ or A plants can be planted in a cultivation trough to force them in a tunnel. Then, around mid-June or as soon as possible after clearing the early crop, the troughs should be placed on the gutter or in the Hochstädter Damm.

The first winter flowers will open at the end of May, following which the first flush of fruits can be picked from the end of June. The tray plants and mini tray plants will produce a larger first flush than the smaller plant types.

The formation of new flower buds only starts when the plants are receptive to flower bud formation. The cold that the plants have had causes delay. If this delay lasts 5 weeks, the plants would not be able to produce flower buds again until early June.

The harvest of the first flush will drop off temporarily from mid-July. Production will start to increase again from early August because flower formation only started again at the beginning of June (after a period of not being receptive).

Picture 16: Everbearers or in a Hochstädter Damm

9.7 Cultivation on table tops under small tunnels

Recommended varieties: Favori Furore Bravura Altess, Hademar, Florentina and Florina

Recommended plant material: Cooled tray plants, mini tray plants, plug plants, A+ and A are suitable for this cultivation method

Harvest period: from late May until late September

J	F	M	A	M	J	J	A	S	O	N	D

With everbearing varieties on covered table tops, it is possible to pick good-quality strawberries for at least 4 months continuously. With June-bearers, a second crop in the season is possible at most after a very early cultivation. In total, an everbearer can realise a higher production per running metre on this type of table top.

Cultivation method and harvest progress

From late February, cooled tray plants, mini tray plants, plug plants, A+ or A frigo plants can be planted. The substrate temperature should preferably not fall below 8°C.

The first winter flowers will open from late April, after which the first flush of fruits can be picked from late May.

The formation of new flower buds only starts when the plants are receptive to flower bud formation. The cold that the plants have had causes delay. If this delay lasts 5 weeks, the plants would only be able to produce flower buds again from mid-April.

The harvest of the first flush will drop off temporarily from late June. Production will start to increase again from early July because flower formation only started again around mid-April, after a period of not being receptive to flower bud formation.

Picture 17: Everbearer on table tops under small tunnels

9.8 Illuminated winter cultivation

Recommended variety: Favori

Recommended plant material: freshly cut mini-tray plants

Harvest period: from late October to mid-April, possibly longer

J	F	M	A	M	J	J	A	S	O	N	D

The search for a reliable method to achieve a high production of excellent quality strawberries from everbearing varieties, even during the darkest winter months, continues. Good results have already been achieved, but it is not yet entirely clear exactly which knobs need to be adjusted in order to steer the plants in the direction the grower wants.

Cultivation method and harvest progress

Fresh mini-tray plants are planted in the greenhouse around 15 August. These plants are then cut around 1 July in the same year.

The daylength extension lights must be switched on from 25 August to allow the plants to experience a long day at all times. It is preferable to create a day length of 16 hours, in which case lighting should be started 16 hours before sunset. As a result, the plants will experience a natural transition to the night.

In the beginning after planting, there is still enough natural irradiation, so that additional lighting with LED light is not necessary. Additional LED lighting is not even desirable until 15 September because the assimilate requirement is still limited at that time. An amount of 10 mole PAR light per day (measured at crop height in the greenhouse) appears sufficient until 15 September.

As the size of the crop increases, the LED lighting should be increased in steps between 15 September and 15 October until a total PAR level of 15 mole is reached. This step-by-step increase is possible on the one hand by initially only working with an LED illumination duration of 14 hours, while daylength extension lights continue to make the day length of 16 hours.

Another possible measure at the same time is to only switch on the LED light when a certain amount of radiation in Watts per m2 is not achieved and to switch it off when the number of Watts is exceeded. Between 15 September and 15 October, the number of realised moles per m2 must be brought to the maximum level of 15 moles per m2 in a smooth line. In this way, the supply of light energy can keep pace with the assimilate needs of the crop.

In terms of light spectrum, it is important that far-red light is administered in addition to blue and red light. This spectrum is important for the extension of petioles and trusses. When using 'flower bulbs', the plants automatically receive far-red light. If this is not enough, additional far-red luminaires can be installed. However, more research is needed into the correct spectra for this cultivation strategy.

After New Year, the amount of natural radiation slowly increases again. From this date, the amount of LED light can be gradually reduced again if it exceeds the maximum daily total of 15 mole PAR light per m2.

Until the end of the cultivation, a radiation sum of 15 mole PAR is sufficient. If the harvest lasts until mid-April, the daylength extension lights can be switched off in early March. For example, when the harvest is extended until July, it is preferable to continue to use the lights to extend the day until April, because otherwise flower bud formation will slow down too early.

During cultivation, old and worn leaves must be removed regularly. This is best done every 2 weeks, removing a maximum of 2 worn leaves per plant. This allows more light to reach the young leaves. Semi-worn leaves often contribute to no more than 50% of the photosynthesis, so that is better to remove these in favour of young active leaves.

The harvest of this crop can begin at the end of October and can continue well into spring, depending on the condition of the crop and the grower's objectives.

Picture 18: Favori in illuminated winter cultivation

9.9 Summer cultivation on soil ridges with black foil, possibly protected from the end of August with high or low tunnels.

Recommended varieties: Florentina and Florina

Recommended plant material: Frigo A or A+ plant

Harvest period: from early July until late September

J	F	M	A	M	J	J	A	S	O	N	D

This relatively simple cultivation is carried out on a large scale in Germany. At many farms, this cultivation method has replaced a late cultivation with June-bearers. The harvesting labour of this crop is more spread out than that of a June-bearing crop. Product sales can also be spread out over a longer period.

Cultivation method and harvest progress

This crop is planted during March, weather permitting and if the soil temperature is preferably not below 8°C.

Soil ridges are created before planting. The ridges are then covered with black foil. At the same time, T-tape or another inline dripping system is installed, which is placed on the ridge, under the foil.

In this system, the rows are 1 metre apart. 4 to 5 plants are planted per linear metre in the rows. After planting, the ridges are often covered with horticultural fleece to create extra earliness.

The plants flower in May. However, the first trusses of these plants are removed, to encourage more vegetative growth first. In this case, harvesting will start a little later, around 1 July, but the quality of the fruits will be better and the final yield higher. Moreover, harvesting in this way only starts when the large harvest of the wintered June-bearers in the field is over.

The end of the harvest is highly dependent on the weather conditions from late August. With a pleasant late summer, the harvest can continue until October. With a bit of bad luck due to a lot of rain, the harvest may be largely over by late August.

For more certainty to be able to continue harvesting long into late summer, some growers will install tunnels over the plants in the second half of August.

Picture 19: Everbearer on soil ridges

Variety selection

The best choice for a particular variety depends on many factors. The market on which the grower focuses with the product is one of the most important starting points on which to base the choice of varieties. For some markets, a reasonably long shelf life is a demand, for other markets the ultimate taste is an unconditional requirement.

Overly fragile strawberries not stand a chance in the supermarket channel. A very productive but neutral-tasting strawberry means insufficient repeat purchasing in the direct sales channel. Every market requires a compromise between shelf life, taste and other quality features.

In addition to the market targeted by the grower, the local climate, the type of soil or substrate, the cultivation system, the grower's experience and personal preferences also determine the variety choice

Picture 20: Florentina

Favori, the ultimate flavour in everbearers

Picture 21: Favori

Plant variety rights number: 2011/1346
Plant variety rights owner: Flevo Berry Holding

Fruit characteristics

- recurring winner of public taste tests.
- Conical, slightly elongated fruits with a pleasant aroma.
- Warm sweet taste, with a light fresh-sour accent.
- The colour is an intense red.
- A firm fruit skin and a soft bite.
- The fruit is glossy, even after storage in the cold store.
- The fruits have an interestingly long shelf life.
- Very suitable for both the supermarket channel and direct sales to consumers.
- Favori fruits are fairly rain-resistant.
- Low sensitivity to pressure marks.
- The calyx stays fresh-green for a long time.
- Periodically, the fruits can be a little seedy.

Plant characteristics

- A productive everbearing variety.
- A fast grower with large leaves.
- Tolerant to root diseases and very strong against mildew.
- The sturdy trusses are long and protrude above the leaves.
- Truss breakage hardly ever occurs with Favori.
- Favori has few fruit deformity issues after hot spells.

Recommendations

- This variety is suitable for soil cultivation on raised beds and for all substrate crops.
- Favori thrives in illuminated winter cultivation under glass.
- During planting, the soil temperature must be > 8°C.
- When the air temperature in spring is < 12°C, covering with foil is preferred.
- Be aware of calcium deficiency. Have plant sap analyses carried out regularly.

Bravura, an everbearer with bravado

Plant variety rights number: 2015/2404
Plant variety rights owner: Flevo Berry Holding

Picture 22: Bravura

Fruit characteristics.

- Uniform conical fruits.
- The uniform orange-red colour does not darken after storage.
- The taste is sweet, with a slightly fresh accent.
- The fruit skin and flesh are quite firm, making them less sensitive to pressure marks.
- Bravura is suitable for both the supermarket channel and direct sales to consumers.
- The shelf life is more than sufficient, long distribution channels are not an issue.
- Average fruit weight can be considered good.
- The fruits can be somewhat seedy from time to time.
- The fruit calyx is bright fresh green and remains that way during storage.

Plant characteristics

- A productive everbearer.
- The plant type is compact with relatively short but sturdy flower trusses.
- The leaves are large and bright, fresh green.
- The plant quickly makes side crowns in which flower trusses develop.
- The pollen quality is excellent.
- The fruits are relatively less likely to show damage caused by thrips.
- Bravura also maintains a good fruit size during hot periods.
- The variety does not have any irregular nutritional requirements.
- To date, Bravura has shown little sensitivity to mildew.
- Periodically high root pressure may spontaneously break a petiole.

Recommendations

- Bravura is highly suitable for substrate cultivation, but also for over-winter cultivation in soil ridges under tunnels.
- With illuminated winter cultivation under glass, this variety shows insufficient elongation.
- Overripe fruits also remain light red in colour, so harvest at least twice a week.
- A slightly higher potassium level in the nutrition can make the fruit colour more intense red.

Florentina, an all-rounder

Plant variety rights number: 2011/1344
Plant variety rights owner: Flevo Berry Holding

Picture 23: Florentina

Fruit characteristics

- Beautiful strawberry red, juicy and attractive fruit with a good texture.
- A very nice balance between sweet and sour.
- Florentina skin is firm and often extremely shiny.
- The fruit colour and gloss are maintained even after storage.
- The fruits can be somewhat seedy from time to time.
- The fruit has a conical to round-conical shape and can sometimes be a little grooved.
- The strawberries are suitable for both the supermarket channel and direct sales to consumers.
- The calyx is somewhat sunk into the flesh.
- Florentina is moderately sensitive to pressure marks and botrytis.

Plant characteristics

- A very productive everbearer variety.
- The plant bears beautiful large flowers.
- It is a generative plant that easily produces new flower buds.
- Florentina can be grown in good balance.
- Its production pattern is fairly continuous.
- Florentina's dark green foliage is compact and sturdy.
- The fruit stalks are sturdy and sufficiently long.
- The flower quality is generally excellent.
- The first flower of a truss sometimes opens when the cluster is still between the leaves. This makes it more difficult to pollinate.

Recommendations

- Florentina is suitable for substrate and open-ground cultivation.
- During planting, the soil temperature must be > 8°C.
- Florentina is a vigorous grower, so do not plant too densely. A maximum of 4 to 5 plants per linear metre in a 1-row system on ridges is common.
- This variety should not be planted too deep. The rhizome must be kept clear of the soil. New side crowns grow from the lower part of the rhizome.
- When the first flowers appear, it is best to remove them to obtain sufficient vegetative growth first.
- This variety does not have any special nutritional requirements, but magnesium must be sufficiently present during the start. Potassium must be made available to a relatively large extent from the harvest period.
- Preventive treatment against *Phytophthora cactorum* is highly recommended.
- If wet periods are expected, colletotrichum and botrytis should have extra attention.

Florina, enormously productive

Picture 24: Florina

Plant variety rights number: 2008/1320
Plant variety rights owner: Flevo Berry Holding

Fruit characteristics

- Large glossy bright-red fruits.
- The fruit shape is conical.
- The fruits do not darken during storage.
- The fruits are easy to pick and picking performance is high.
- Florina tastes fresh, without a pronounced aroma.
- The variety is fairly resistant to rain.
- Due to its good shelf life, Florina is suitable for the supermarket channel.

Plant characteristics

- A very productive everbearer variety.
- The flower trusses are long with large flowers.
- The variety is easy to grow in a good balance between generative and vegetative.
- Florina can be harvested relatively early. If the winter flowers are not removed, the first harvest is possible from late May in open-ground cultivation.

Recommendations

- Florina is suitable for substrate and open-ground cultivation.
- Florina is preferably planted in fresh, healthy soil.
- The rhizome must be kept clear of the soil when planting.
- This variety can be planted early in the year, provided the soil is not colder than 8°C.
- When in spring, after planting, the air temperature is < 12°C, it is wise to cover the plants with foil to avoid growth slowing down excessively.
- Extra attention to *phytophthora cactorum* is recommended, Preventative measures should be taken.
- To continue to harvest good quality fruits in late summer, it is recommended to cover Florina with tunnels from the end of August.
- Florina is relatively sensitive to magnesium and manganese deficiencies. Adjust during cultivation based on regular plant sap analyses.
- Potassium must be made available to a relatively large extent from the harvest period.

Furore, tasty and productive

Plant variety rights number: 2013/2225
Plant variety rights owner: Flevo Berry Holding

Picture 25: Furore

Fruit characteristics

- Bright orange-red and shiny cone-shaped fruit.
- Furore makes a good impression in taste tests.
- Very juicy strawberries with a nice bite.
- Furore has a pleasant aroma and a complex, well-balanced sweet and sour taste.
- In case of excessive peak load due to fruits, the taste can be somewhat neutral temporarily.
- Good fruit size and high percentage of class 1 fruits.
- The fruit skin is relatively sensitive to damage in hot weather.
- The fruits of Furore do not easily tear under the calyx.
- The product is suitable for sales via the supermarket channel and direct sales to consumers.
- Periodically, the fruits can be a little seedy.
- Very attractive fresh sepals.

Plant characteristics

- Fruiting remains good during very hot weather.
- Sometimes the flowers stay somewhat hidden between the leaves, making fruiting less successful. Therefore, remove worn out leaves in due time.
- Furore is tolerant to mildew and phytophthora cactorum.
- The fruits are not likely to be damaged by thrips.
- This variety easily produces side crowns, in which new flower buds are quickly formed.
- Furore is a fast grower and has a relatively small drop after the first early harvest peak.
- A high yield is possible, even with a light frigo plant as a basis.
- If the plants are too generative, the variety can produce such an amount of flowers that it is detrimental to the plant. This is why a vegetative stimulus can be necessary.
- In French research, Furore showed relatively low susceptibility to *drosophila suzukii.*

Recommendations

- Furore is suitable for substrate and open-ground crops.
- When fertilizing, be cautious that manganese and boron content do not rise too high.
- Extra attention to magnesium in the nutrition is needed. Furore absorbs calcium very easily, which may compromise the absorption of magnesium. In Furore, the absence of magnesium shows up quickly.
- Furore is a more generative variety compared with most other everbearers. The variety does not easily become overly vegetative, so ammonium is required to maintain a sufficient balance between generative and vegetative growth.
- In open ground cultivation, the first trusses are best removed until the plant develops well vegetatively. If the heart leaf is small and on a short petiole, this is often a sign that the plant is too generative.
- The variety is suitable, among others, for a winter crop in soil ridges under a tunnel.

Altess, flavour bomb

Picture 26: Altess

Plant variety rights number: 2013/0898
Plant variety rights owner: Flevo Berry Holding

Fruit characteristics

- The glossy fruits are packed with flavour.
- When fully ripe, these strawberries have a powerful aroma.
- For a better shelf life, preferably harvest the fruits before they are fully ripe.
- A reasonably large fruit size, also during warm periods, provided that root development is good.
- The fruit is conical in shape.
- The highly visible strawberries are easy to pick.
- The yield is usually comparable to Florentina, but Altess produces fruits that are less likely to be seedy.
- The strawberries are suitable for the supermarket channel and direct sales to consumers.
- Storage of the fruits hardly affects the colour and gloss.
- The fruits are fairly resistant to rain.

Plant characteristics

- An everbearer with a simple plant structure.
- Altess grows easily.
- The plant can withstand hot periods, provided the roots are well developed.
- Altess is strong against botrytis, root diseases and mildew.
- Thrips damage is not often visible on the fruits.
- The variety does not have any irregular nutritional requirements.
- Little labour required for leaf picking.

Recommendations

- Altess is suitable for substrate and open-ground cultivation.
- Paying extra attention to good root development is recommended, such as avoiding wet spots and poor structure in open-ground cultivation.
- In open-ground cultivation, raised soil ridges are preferable to flat field cultivation.
- During planting, the soil temperature should not be < 8°C.

Hademar, the youngest addition

Plant variety rights number: 2015/2405
Plant variety rights owner: Flevo Berry Holding

Picture 27: Hademar

Fruit characteristics

- The fruit size is quite large.
- The fruit has a beautiful gloss, even after storage.
- The taste of the strawberries is fruity and sweet.
- The fruits are beautifully red, both on the outside and inside.
- Hademar has very firm fruits that are not very sensitive to pressure marks.
- The percentage of class 1 fruits is generally high.
- Hademar's bountiful harvest is well spread out.
- The strawberries are suitable for both the supermarket channel and direct sales to consumers.

Plant characteristics

- Everbearing variety with a continuous production
- The plant balance is nearly always excellent. Continuous flowers and fruits. This variety is unlikely to come to a standstill.
- Periodically, Hademar may suffer from misshapen fruits. In several cases, flower pricking bugs appeared to be the cause.
- The trusses are long and protrude above the crop.
- Truss teasing is relatively easy, because the long trusses of this variety largely grow automatically towards the outside of the row.
- Thrips damage does not seem to show up easily on the fruits.
- Hademar does not appear to have any particularly different nutritional requirements.
- The variety is strong against root diseases and mildew.

Recommendations

- Hademar can be grown on substrate as well as in the open ground.
- Some foliage may be removed between the first and second harvesting flushes. The plant easily grows new leaves.

Flevo Berry

Flevo Berry is a leading strawberry breeding company. In a relatively short time, we have built up a strong position in Europe with our varieties. We breed for varieties with which growers can produce tasty strawberries year-round, grown with respect for people and nature.

We always look ahead when developing new varieties. It can be done differently, it has to be done differently, with taste and sustainability being paramount. It's in our DNA.