

Kalanchoe
Culture guide

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PREFACE

A fertile breeding ground for a flourishing cooperation

Fides Potplants and FGB are working closely together in breeding and propagating flowering potplants and cutflowers (chrysanthemum).

Fides Potplants concentrates on the sale of cuttings of the company's potplants, which include Kalanchoe and various seasonal products such as Impatiens New Guinea, Fortunia®, Dahlinova® and Fuchsias. In The Netherlands, Fides Potplants also sells cuttings of pot chrysanthemums and Garden Mums. Broad experience and modern production facilities guarantee a high quality.

FGB's main activity is breeding chrysanthemums, Kalanchoe, Tamarinda® (Impatiens NG) and Fortunia®. Its other concerns are the global marketing and the issuing of licences of the extensive range of varieties. FGB moreover makes improved selections of existing varieties and performs research into technical aspects of cultivation, for example in the fields of crop protection, fertilization and climate control.

Fides Potplants and FGB owe their great success to their vast experience and impressive know-how in the fields of breeding, propagation and marketing. Add to this products of the best possible quality and a strong emphasis on innovation and you have a highly fertile breeding ground for a flourishing present and future.

Supportive advise

This Kalanchoe culture guide is the result of many years of trials and research. It is a collection of all the knowledge which has been built up from this research and from practical experience. Because of the different circumstances at each nursery, this culture guide must be seen as supportive advise. Therefore, the staff of Fides Potplants and FGB is always willing to serve you with advise in your specific situation.

§ 1 INTRODUCTION

1.1 Origin

The Kalanchoe belongs to the Crassulaceae family. Most of the botanical species can be found on the Island of Madagascar and in eastern and southern Africa.

The Kalanchoe family can be divided into three sections:

- Eukalanchoe (from which almost the entire FGB range originates, the Kalanchoe blossfeldiana being its most important botanical parent).
- Bryophyllum (from which most of the hanging Kalanchoe types originate, characterized by hanging flowers)
- Kitchingia (a small section, also characterized by hanging flowers)
(The well-known Fanny Bells originate from these last two sections.)

1.2 Multiplication

The Kalanchoe can be multiplied vegetatively (by cuttings) as well as generatively (by seed). For production ends only vegetative multiplication can be used. Modern Kalanchoe breeders and growers without any exception multiply vegetatively only. Varieties of these breeders do not come back pure from seed and will have to be multiplied by tip or eye cuttings.

1.3 Cuttings

Until the mid 70's the most important way to produce cuttings was the 'cutting-from-cutting' method. When however it became apparent that this was not in the least beneficial to the crop, a change to cutting production via mother plants by means of top or stem cuttings became necessary.

The mother plant culture is a difficult culture because of the high demands such as good substrate, good nutrition level, selection and very strict disease control.

What is a good cutting?

A cutting for standard Kalanchoe culture (4 inch pot/10½ cm) must have at least 2 medium-sized pairs of leaves, which are about 2/3 the size of a full-grown Kalanchoe leaf. After picking the cuttings (to cut is even better) it is recommendable to let the cutting material be for one day (at a temperature of 12-16°C, in a dry, dark or shady place). The wound surface will now be able to dry, which reduces the chance of infestation during rooting. And, as the cuttings become a bit slacker after 1 day storage, the chance of breakage during sticking will be smaller as well.

Keeping the cutting material longer than 1 day is not impossible (the maximum is normally 1 week), however depending on several factors, like variety characteristics, nutrition level inside the cutting, place and way of storage.

The storage room must be airy and dry with a constant temperature between 12-16°C.

1.4 Delivery

The supplied cutting material must meet with many requirements, which are essential for the further development of the crop.

More than 18 years of trialling in this field resulted into a wealth of data which is mirrored in the quality of the cutting. In breeding FGB aims to increase the quality of its varieties with each new introduction.

The cutting material must:

- be healthy (disease free)

The starting material for the mother plants originates from a cleaning program; the material has been tested for all known viruses and bacteria (if possible) and has been made virus-free by a specific treatment.

A stringent crop control in mother stock is executed by FGB itself every week (often even twice a week) via pest monitoring in order to destroy the affected and/or 'suspicious' plants.

Besides that, a disease control program is executed on a regular basis.

- have sufficient nutrient buffer stock

thus ensuring the cutting on the motherplant of sufficient nutrition, which will harden the cutting and reduce the chance for cutting losses during rooting.

- be of quality

Besides health and sufficient nutrient buffer stock, the cutting must perform well: be a good brancher/shooter, a fast rooter, etc. (To this end new selections are constantly being built up, tested and compared; the very best selection will be chosen as the new starting material.)

- be uniform

Hereto FGB has developed a grading system by which the pickers can read the exact desired cutting size, e.g for a certain pot size.

By this a high percentage in uniform growth can be achieved.

1.5 Fides Elite System

Since many years Fides is working with an own quality-system concerning the health of Kalanchoe cuttings, called the Fides Elite System.

From the year 2000 all Fidesvarieties grown in the world are clean, that means free of all known virus and bacteria.

Severe standards in building up stockplants made this possible, like insect-free greenhouses, many tests in the laboratory, regular flower-trials. All this to quarentee as much as possible the inside and outside quality of the varieties.

§ 2 CULTURE (STANDARD)

2.1 Potting soil

The medium used for Kalanchoe must conform to 4 important criteria:

The soil:

- must be airy;
- must be light and freely-draining;
- must not dry out too fast and must have the ability to hold water;
- must be suitable to the method of irrigation.

Many soil mixtures on the basis of peat are possible, but currently a basis of 80% Finnpeat and 20% Irish peat is most common.

To increase the air in the medium, you can use flugsand, perlite, styroporgrains (polystyrene), clay-grains or rice-hulls. Some of these additions will help retaining the water. Further you can use rockwool or oasis to this end.

The pH level of the soil must be between 5.5 and 6.0. In order to get a good basic pH level of the soil, you can use Dolokal (3-6 kg/m³). To attain that level, you can mix pure calcium through the medium (6-10 lb/m³ - 3-6 kg/m³). It's a known fact that in the first weeks the pH level can drop back to 4.5-5.0. With a calcium and/or potassium fertilizer this can be corrected.

Other adjustments which can be made to the medium is mixing in supply fertilizer (for instance trace elements) and/or a fungicide.

Rooting

Cuttings are usually stuck directly into the final pot.

Normally spoken it is not necessary to use fungicides in the rooting period for protection. When the cutting is healthy and the circumstances are not too extreme, it should not give any health problems. However, there are other circumstances.

Rooting hormones are not necessary (hardly no effect). (However they can be used when slow-rooting varieties are grown. It can speed rooting by 2-3 days and that can be just enough to level them with quicker rooting varieties, which means that they can be put in the SD phase at the same time.)

The cuttings can be dipped in a fungicide or sprayed with a fungicide just after sticking. Dipping in a fungicide, together with a rooting hormone can have a positive effect on the start. Also a treatment of the medium before sticking is possible.

Later in the rooting period problems with moulds might occur (Rhizoctonia, Phytophthora, Pythium). It is therefore necessary to follow the growth closely and take action when needed.

The rooting period (or LD period) will take about 3 weeks in the summer and 4-6 weeks in the winter (depending on variety, environmental conditions, plant size desired etc.) for a standard pot size (4 inch/10½ cm).

We recommend a rooting temperature of 21-23 °C (70-74 °F).

Quicker rooting can be gained by using:

1. bottom heating,
2. covering of plastic (± 10 days),
3. assimilation lighting.

Both heat and lighting can reduce rooting time by at least a week. Covering with plastic has the big disadvantage that monitoring the crop is difficult. So if a disease is present under the covering, it's always seen too late and it is spreading quickly under plastic.

Using assimilation light and covering can also cause problems. A combination of item 1 and 2 or 1 and 3 is normally not with heat build-up (double effect).

Pots and pot sizes

For Kalanchoe, a whole range of pots - both clay and plastic - can be used, with a preference for plastic pots, as for mechanized systems this means easier handling. Sizes can vary from 2-9 inch in diameter (5 to 23 cm).

The size is the choice of the grower.

The present situation provides us with five main groups:

- * 2-3 inch (5-7.5 cm) mini pots;
- * 3-3.5 inch (8-9 cm) midi pots;
- * 4-5 inch (10-12 cm) normal (standard) pots;
- * 5-6.5 inch (13-16 cm) Big Pots (generally more than one cutting per pot is used, so use uniform varieties);
- * 6.5-9 inch (16-23 cm) Plant-Bowl Cultures.

Besides these groups, bigger pots (for instance for hanging culture) or smaller pots (super mini, 0.75-1.25 inch/2-3 cm) can be used. Especially for the hanging pots it depends on the variety which number of cuttings and pot size are needed.

Spacing (quantity of pots per sq. yard/m²)

During the LD period, the pots can be spaced close to each other, for instance 285 4-inch-pots per square yard (100 10cm-pots per m²). For spacing afterwards the amount of space depends on variety, method of cultivation, desired plant habit, etc.

The average number of pots per m²/sq yard for the most used pot sizes are:

POTSIZE		Number of pots per	
CM	Inch	M ²	Sq. Yard
5.5	2	140-270	75-79
7.5	3	120-160	58-63
9	3.5	50-55	42-46
10	4	45-50	33-38
11	4.25	40-45	29-33
12	4.75	28-34	20-25
13	5	22-26	18-22
15	6	18-22	15-18
21	8.25	13	11
23	9	10	8

2.2 Crop time and Response time

The crop time depends on variety, season, method of cultivation (pot size, pinched/unpinched, temperature), cultural environment etc.

In Chapter 6 we already talked about the rooting period. In addition, the response time can also be different in summer and winter. The difference can be 2-3 weeks (8-11 weeks response time). Generally speaking, the crop time can be from 11 weeks in summer till 18 weeks in winter (in standard 4 inch/10½ cm pot) in northern climates.

Response time is the period from beginning of the Short Day until opening of the first flowers. The response time noted in the FGB brochure is based on the Dutch Auction Standard, 2-4 flowers has to be open and that for 80% of the crop. The Dutch Auction Standard however is an exception. In almost any other country the plants are sold with 10-20 flowers open. So the response time mentioned in FBG variety lists is based on the Dutch situation. For other countries at least one week must be added.

Every variety has its own response time (genetic). In one year the difference in a variety can be 3 weeks or more. A so-called 10 weeks variety has a range of 9-12 weeks. The reason is unknown, but it has to do with the total sum of light-intensity and how that's divided through the culture.

Temperature can influence the response time as well. Temperatures below 18°C (62°F) or above 28°C (84°F) slows down the culture, while temperatures between 22°C (70°F) and 28°C (84°F) can speed up the culture.

Long Day and Short Day (LD and SD)

The Kalanchoe is a so-called Short Day plant, which means that when producing year round, assimilation (night-lighting and blackout) are necessary.

That is why we talk about Long Day and Short Day.

Long Days (LD) are given in the beginning of the culture, to promote rooting and vegetative growth.

Short Days (SD) are given in the rest of the culture to promote flowering.

It is important to determine when the LD period ends and the SD period starts. It depends on a number of factors, such as rooting, pot size, plant size/habit desired, pinched or unpinched culture etc.

Lighting (Long Day)

The Kalanchoe is a Short Day plant, with a critical day length of 12½ hours. In the winter period (15/9 till 31/3) the Kalanchoe must be lit to prevent bud formation in the vegetative stage. Two methods can be used:

1. cyclic lighting;
2. assimilation (supplementary) lighting.

For cyclic lighting electric bulbs can be used (150 Watt). The installed capacity must be 12 Watt/sq yard (15 Watt/m²). This equals 100 lux. The cycle must be 10 minutes per half hour. Light must be given between 3 and 6 hours, depending on the time of the year. With this type of lighting it is also possible to give light continuously during at least 2½ hours a night (between 23.00 and 02.00 hours).

With assimilation lighting you use SON-T (400 Watt) lamps. Besides preventing bud formation, this type of light has also effect for better growth: quicker rooting, stronger development, better shoot formation and more shoots.

Therefore a light capacity of 24 Watt per sq. yard (30 Watt/m²), that is approximately 2,000 lux, is needed.

Installation depends on many aspects. For every situation - every greenhouse - there is a different advice.

In the winter period assimilation light can also be used in the Short Day. The installation must be around 2500/3000 lux per m² and can be used throughout the whole SD period.

In the first 6-7 weeks it must be 10 hours a day, while in the last weeks until flowering it can be brought to a maximum of 17-18 hours. We advise however for the whole SD period 10 hours, because of the costs. 18 hours gives an extra production improvement, but it is not enough to cover the extra costs.

And there's also a practical reason. With 10 hours you can still use a complete SD area. If some of the sections are getting 18 hours, that means extra screens to avoid light going to sections where only 10 hours are to be given.

The quality improvement with 10 hours a day is significant enough.

Besides the quality improvement it reduces the total crop time mostly by 2 weeks, in some periods however with 3 weeks.

(USA – 1 Footcandle = approximately 10 lux).

Black-out (Short Day)

Black-out means that during the summer period (15/3 till 15/10) the crop must have artificial short days, in order to get flowering plants.

In the bud formation period, the Kalanchoe needs at least 14 hours of darkness.

The period needed is at least 6 weeks, but we advise to maintain that until flowering, because that is better for the development (and growth control) of the plant. It does not harm the crop, on the contrary, it will improve quality (more compact plants).

Furthermore, you have to take the following into consideration:

- Do not use Short Day Interruption.
- The first 6 weeks must be uninterrupted. Do not miss one single night of blacking-out.
- It must be completely dark in the SD (holes and tears in the SD material, can effect spots of the crop). Measurements of more than 10 lux under the screen create problems.
- Be aware of light outside greenhouses: street lights, light from neighbouring greenhouses, etc.
(In this case bud formation disturbances can even be caused by the moon).
- The choice of the screens is very important. We advise not to use black-out plastic because of the climate in the greenhouse. A screen which can "breathe" (exchange of temperature and humidity under and above the screen) is preferable.

(There are screens where, if measured, in a closed situation no measurement of lux can be found, but it still seems light enough to read the paper. Those screens are mostly not suitable for Kalanchoe.)

2.3 Pinched or unpinched culture

A long time ago pinching meant cutting the top of the plant off and used that for the next crop. Later it meant taking away the growing-point, which meant that also the bottom lateral shoots came till full development.

The development of the sortiment lead to the present situation, that pinching is hardly necessary, because the varieties are so powerful, that all shoots come out anyway.

Only the months december and january in Northern Europe are an exception on this situation.

However, there are still growers which chooses to pinch.

This is the choice of the grower, but depends on variety, season, pot size, method of cultivation, desired plant size, habit, etc.

There are 3 types of varieties:

- Varieties which best can be grown without pinching,
- Varieties which best can be grown pinched,
- Varieties which can be grown or pinched or not-pinched.

The season is generally called the winter or summer season. In the summer it is for most of the modern varieties not really necessary to pinch.

Generally spoken, the different pot sizes can be divided into unpinched and pinched cultures:

- Mini and Midi cultures: Always unpinched.
- Standard and other cultures: Choice between the two.

Pinching was a topic of discussion the last few years. Not only the right size is being examined (do we pinch the very small top-growing point, or do we pinch a small cutting?), also the right time for pinching is.

At the moment there are two methods of pinching that can be used.

The first one is to pinch either just before spacing, or at the moment of starting the Short Day (after spacing). The correct time depends on the speed of rooting.

Not every variety needs to have side shoots present before pinching.

However, the modern varieties are so freely branching, that even when no side shoots are visible, the finished plant will still have many branches.

Normally it is best to pinch when the side shoots are up to 0.2 inch (0.5 cm) and best not longer.

For a standard 4 inch/10½ cm culture we suggest pinching to 2-3 leaf pairs in the summer and 3-4 in the winter (leaf pairs above the media level).

This method of early pinching is in some crops necessary, because it stimulates the development of the lowest lateral shoots.

There are several reasons not to pinch. In the summer it is not really necessary to pinch for the desired plant shape - not pinching gives a more pyramid-shaped plant.

The second method of pinching is the late pinch, which is used more and more.

This method was developed in order to reduce the need for not the culture itself, but the need to use less growth retardants.

The late pinch method involves pinching after 7 days in the Short Day. That means generally a reduction in treatment with growth retardants by 2 times. (If a variety needs in the first method 3-4 times a treatment, it now only takes 1-2). The biggest advantage of this method is the reduction of growth retardants, but besides that we have noticed that the crop finishes quicker (5-6 days) and the branching is generally a bit better.

A disadvantage is that it can be necessary to remove some of the top leaves (that is the leaf pair just under the pinching point), because they are too big. (This can also happen in other crops, it is not unique for this method, but more common).

In the northern climates' situation it may be necessary not to use this method during Week 45-Week 6 (the dark winter) and to go back to the first method, as the vegetative part of the plant is not developing enough then.

(It is perhaps needless to say that this method can only be used by nurseries which can easily reach every plant in the Short Day).

In both methods the right size, according to the present opinion, is to take a soft pinch (or a very small cutting).

Shoot stimulation

Shoot stimulation can also be gained by cultural methods and chemicals. Pinching in the Short Day gives a better result on branching (see previous topic).

There are two chemicals, which can stimulate shoot growth, Atrinal and Benzyladenine (BA) (not registered in every country). Both are useable but tricky and unreliable. Therefore we do not advise these. When using these chemicals deformation of the plant, flower damage or a total cessation of growth can be expected.

Growth stimulation

Once in a while gibberellin (GA_3 -Berelex) is used to stimulate the growth.

We do not advise it, unless there is a very good reason. Mistakes in using it are easily made, mainly because of the very low rate, that must be used. In practice growers occasionally use it, but then it is used as a "neutralizer" of a stunting Bonzi-treatment.

Growth reduction

Summary on growth reduction:

- It is necessary to keep Kalanchoe compact, otherwise the stems are not strong enough to support the flower-heads.
- Growth reduction is done in the first place by chemical retardants, like Alar, Dazide, Bonzi and in countries where these chemicals are not allowed Topflor or B-Nine.
- Before using the chemicals, check the rates carefully.
- There are new methods other than growth retardants to keep them compact.
- Combinations of methods, together with the new generation of varieties, means that the of chemical treatments are reduced.
- Before changing any cultural practices, run a trial on at least 25 plants and evaluate the results.

Growth reduction can be done by cultural methods and by growth retardants. Cultural methods are increasingly being trialed, because of the growing pressure to abandon chemicals for environmental reasons.

Additionally the breeders have reached quite some success in introducing varieties, that don't need as much chemical treatments (for some varieties or in some periods during the year, even nothing at all).

For chemical growth reduction there are several chemicals, among which Alar and Bonzi are the most important ones. In some countries (e.g. Germany and Austria) Topflor is used, while in the USA Alar is substituted by B-Nine.

Alar 64 is used in a concentration of 4 g/l, for Alar 85 (Dazide) that is 3 g/l.

(B-Nine is applied in a rate of 2500 ppm).

Frequency of treatment depends on variety, season, desired plant size, pot size, etc. A guideline of treatment is not easy to give, but in general the guideline for standard culture is:

- | | |
|---------------------|---|
| - 1x per week | Summer (mid May till late August) |
| - 1x per 10-15 days | Autumn (late August till mid November) |
| - 1x per 2-3 weeks | Winter (mid November till mid February) |
| - 1x per 10-15 days | Spring (mid February till mid May) |

The information as described sofar is based on the culture ideas, which were common until the year 2000. In the period 1997-2000 FGB undertook a wide range of experiments, among others a large international research on growing without retardents. Other research, not only carried out at FGB, but also at the Research Station in Aalsmeer, was conducted in trying to find out the right time to use retardents. The results of these experiments lead towards another approach towards the culture. The basic filosofie about this approach is that not the circumstances (plant and climate) are the deciding factor in the culture, but the grower. By using this approach (a revolution in growing), the grower has a far better control on the culture. Also important was that it lead to a significant reduction on the costprice and a higher profid from the culture.

The central issue in this approach is manipulation of the Long Day period and a more exact use (read the right time of application) of retardents. There are two crucial periods for retardents, one during the Long Day period, the other one in the Short Day period, more exact during the flower induction period. Also the amount of fluid used is critically important. We separate three methods:

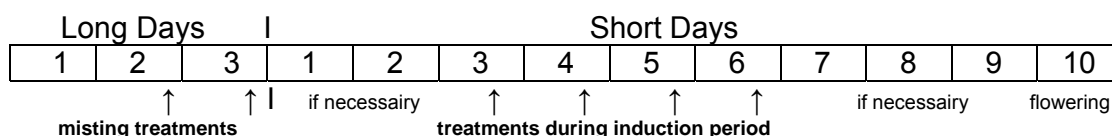
1. Misting treatment. The purpose is to stop the growth of the headshoot. This is the treatment for the Long Day period and occasionally in the Short Day period. The amount of fluid used is half the amount used by normal spraying.
2. Spraying treatment. The purpose is to slow down the growth of the whole plant. This is the normal standard treatment.
3. Watering treatment. The purpose is to stop the growth of the plant completely. This is a treatment like giving water.

Starting with the Long Day period. The most significant change here is the shortening of this period. Generally spoken we talk about a reduction of Long Days by 7 days. Also a treatment with retardents in this period is part of the system. However, this is not a normal treatment, but a so-called misting treatment. The rates are kept the same, but the amount of fluid used is half as normal. By using this kind of treatment, the result is not growth reduction on the whole plant, but only the head shoot, so the side shoots can still develop. The plant grows more widely. So in this stage too many stretching is prevented, especially stretching of the bottom part of the stem. The frequency and amount of treatments is depending on variety, variety, time of the year and the required plantsize.

Secondly we have the Short Day and more precisely the induction period. In this period the use of retardents (normal spraying) turns out to be the most efficient method, avoiding negative growth (meaning stretching) and also leading to a reduction in costprice. Generally speaking the induction period is between the 3^d and 6th of the Short Day. This is the period when the plant fully switches from a vegetative to a generative (flowering) plant. Research showed that this period has a very big influence on the endproduct. One of the discoveries in this is that stretching is already initiated in this period, when the climatical conditions are not in favor. Strong fluctuations in humidity (the main cause of stretching) have a minor influence after the 6th week of the Short Day, but a big influence in the induction period. The exact use of retardents in this period is therefore a great importance. The frequency and amount of treatments are also depending of the time of the year, the variety (response time) and the required plantsize.

However, all this doesn't mean that before the 3^d week of SD and after the 6th week retardents are not necessary. Some treatments still may be necessary.

The following schedule shows the new approach.



Long Day period

1. Slow growing varieties (Goldstrike): 0-1x misting treatment.
2. Normaal growing varieties (Kerinci): 1-2x misting treatments.
3. Strong growing varieties (Tenorio): 2x misting treatments.

Short Day period (the induction period)

1. Varieties with a slow responstime(Goldstrike): treatments in the 5th and 6th week.
2. Varieties with a normal responstime (Tenorio): treatments in the 4th and 6th week.
3. Varieties with a quick responstime (Kerinci): treatments in the 3d and 5th week.

The schedule is based on conditions during the spring, a normal summer and the beginning of the autumn. If the circumstances are different, like the (dark) winter and a hot summer, than adjustments are necessary for this schedule, mainly in the frequency of treatments.

A second chemical is Bonzi. This is stronger than Alar, however more tricky to work with. As a guideline we use:

- Summer: 1.0-1.5 cc/liter
- Autumn: 0.5-1.0 cc/liter
- Winter: 0.2-0.5 cc/liter
- Spring: 0.5-1.0 cc/liter
-

Normally we apply this 1-3 x during the culture with an extra treatment in the end, which is a bit stronger than normal (e.g. in summer it will be 1.25-1.75 cc/liter). Using Bonzi you must consider the following:

- do not use too much liquid (about 80% of what is normal with e.g. Alar),
- do not use it on plants in dry soil,
- check the rate carefully every time,
- be aware of the fact that Bonzi starts doing the job only after 7-8 days.

Another chemical is Topflor, mainly used in Germany. The recommended rate is between 25 (winter) and 50 (summer) cc/liter.

A disadvantage of Topflor is however that it can causes discoloring of the flowers. (No further information available, it is not allowed to use it in the Netherlands.)

Quit common today is the use of a combination between Alar and Cycocel (2 g + 1 cc/liter) or Dazide and Cycocel (1-1,5 g + 1 cc/liter), which give the same result as using Alar or Dazide in a pure way. The combination must be used in the same way and frequency as when Alar or Dazide are pure.

Culture without growth-retardants

Just like the pressure on the use of chemicals is increasing, the use of chemical growth-retardants is a point of discussion. Not that we like this to happen, but reality shows that from outside horticulture the pressure increases.

During 1999 FGB organised a big international research to search for alternatives, with one starting point: growth without retardants.

At this moment it did not lead to conclusions and advise yet, but this research delivered some interesting results, which might bring some solutions in the future.

The first conclusion is however that growing without retardants is possible for a reasonable part of the year, but the varieties available are limited and not all potsizes can be used with all colors.

Culturewise a few items can form the basic of this method:

-Manipulation of the Long Day.

In most cases this means shortening the Long Day by 1-3 weeks, but because of the fact that less varieties are available, it can also mean lengthening the Long Day, if varieties are used, which are normally grown in mini-culture.

-Adjustment of the temperature.

In basic the present temperature-level can be used. But it seems that also Negative DIF can be used on Kalanchoes, but the difference between day (low)/night (high) temperature may not be bigger than 3°C.

-Assimilation light.

This will be especially needed for the winter period (Northern Europe), otherwise the quality is too bad. However, an installed capacity of 3500 lux is not sufficient anymore, at least 5000 lux is needed.

-Humidity.

Especially in the spring and autumn the humidity can be extreme. That is a probable cause for stretching. It is a preference when the humidity can be kept between 75% and 90% during a day, but when the levels are reaching 50% till 95%, the chances of stretching are enormous.

-Fertilization.

The trial sofar proved that the EC does not play such an important part as we always thought. Probably a high EC still helps controlling the growth, but the normal EC (around 1,5-2) is a minor factor in this story.

It is possible that specific chemicals, like N (nitrogen), are important, but that is not sure yet.

2.4 Irrigation

The frequency of irrigation is depending on criteria like seasonal influences, growth activity of the plant, stage of development (LD or SD), the roots, soil type, method of irrigation, pot size and micro climate.

As a general rule you may not give too much water (which causes root rot problems), or too little water (which will cause salt building-up and root scorch), but the medium should be moist.

The water which is being used is also important. We can use rainwater (the best), surface water, drinking (tap) water, well water.

Rainwater is the best, because it hardly has any EC (= low salt level) and a pH level of about 4-5. That means that all the fertilizers must be added completely, which means that you can work quite accurately.

Surface water is not preferred for Kalanchoe. This water might be polluted and Kalanchoe is a sensitive crop.

Drinking (tap) water is only to be used in the event of a dry period (no rainwater available). It has a low EC (salt level), but a high pH level (7-7,5). Using this water means you need to adjust the fertilization schedule, especially in calcium, chloride, bicarbonates, sulphur and magnesium.

Well water is the second best to use for Kalanchoe. However it requires adjustments, especially in bicarbonates and iron.

We recommend to have a water analysis made before using and adjusting the fertilization schedule as appropriate.

The method of irrigation is also important. The best way is from underneath, with an ebb/flood system or with a drip system.

The last years it has become more and more the habit of giving water every day, adjusted to the circumstances outside (when it's warm more water than when it is dark and cold). The grower should always be mindful of the sensitive nature of the Kalanchoe, especially to changes.

The basic idea is that the plant is supplied with water and fertilizers every day, even when it is only a little bit.

Especially with underneath irrigation systems we have seen that a regular supply with water is much better for the growth than once or twice a week.

Giving water overhead is possible, but than more problems can occur. For instance if the water quality is not good enough (pollution) it can cause problems like burning-spots, residue, etc.

Especially in the bud formation period (around 6 weeks in the SD), it can be dangerous to give water overhead (might cause instant flower damage).

When the buds are colouring (starts to open), we strongly recommend to avoid giving water overhead.

If you have an overhead water system, we recommend to give water in the morning. The crop must be dry (or as dry as possible) when the SD screens are closing, in order to protect the crop from moulds or humidity damage.

Temperature

Temperature is one of the most important aspects of the culture. The optimum range lies between 64 and 68°F (18- 20°C), day and night.

Temperatures under 61°F/16°C (day/night) can cause blind eyes or no flowering at all, but certainly causes delay.

With temperatures under 55°F/13°C (day/night) there is hardly any growth and no flowering.

With temperatures over 72°F/22°C (day) there is a slight increase in crop speed, but (night) it also can cause blind eyes, no flowering and other (variety) specific problems.

Temperatures over 84°F/28°C (night/day) there is an increased risk of delay and especially stretching of the plant.

With temperatures over 93°F/35°C (night/day) there is a risk of no flowering at all.

We recommend a constant temperature range, like 64-64°F (18-18°C) day-night or 68-68°F (20-20°C) or a temperature range with only a few degrees difference, like 64°F (18°C) at day and 68°F (20°C) at night.

Especially when the outside temperatures are under 61°F (16°C) there will be a temperature fall (which can create a shock on the crop) at the moment that the black-out screen is opened. We recommend to increase the temperature by one or more degrees (depending on the outside temperature) for a short period, just about one hour before opening. This absorbs the temperature drop later on.

Ventilation starts at 68-70°F (20-21°C).

The use of floor or crop heating is highly recommended. It brings energy to those places in the plant that need it most. (Be aware that this temperature is at all times lower than the normal greenhouse temperature).

Negative Dif temperatures for controlling the (compact) growth of the plant (instead of or in addition to growth retardants), does not work that way in Kalanchoe, when the temperature difference is greater than 3°C. On the contrary, instead of showing compact growth, the plants will stretch (which is the result of the humidity).

Humidity

Related to temperature is the humidity, which proves to be very important for the Kalanchoe culture. It is the main reason for stretching. The general idea was that temperature was responsible for stretching, but it is actually the humidity, off course influenced by the temperature. But the idea that for instance high temperatures causes the stretching is wrong in most cases.

A humidity of 75-85% is ideal, but keeping this humidity on a constant level is even more important.

A high humidity (above 90%) can cause a lot of cultural problems (falling of leaves, yellow leaf spots, damaged flower heads and buds). Although a lot of these problems can be traced back to humidity, it is also possible that other factors play a part in this.

Low humidity (below 70%) can be a problem especially towards in the end of the culture. The root system (heart of the plant) cannot keep up with the evaporation

anymore, meaning that all the energy in the plant is used in the top which causes delay in growth or even stops the growth.

High humidity at night: open the screen 1-1½ yard (1 meter), when it is dark enough.

Low humidity in summer: extra irrigation overhead can help, but can only be done until the 6th week of the Short Day period.

Overall it is very important to maintain a stable humidity, especially inside 24 hours. Too much fluctuations, <75% - >85%, increases the chance on fungi and are the main reason for stretching.

CO₂

CO₂ is as important for Kalanchoe as it is for many other plants. The Kalanchoe originally belongs to a group of plants, which take in CO₂ at night and not in the daytime. These are the so-called CAM-plants. This mechanism has been altered by breeding and also there is reason to believe that adjustment to the cultural climate (read country) where they grow, is playing a part in this.

At present we recommend to supply CO₂ mainly in the daytime. In the nighttime it can be used, but we doubt the value of doing that. (Most likely a little effect). Only when temperatures are for a long period over 87°F (30°C), we assume that night-supply has more effect.

CO₂ gives, when applied in the right, a better (and faster) growth and bigger (stronger) plants. Especially in the winter season it is a necessity, because in this period plants are growing slower anyway. We recommend the supply of CO₂ with a rate of 700-800 ppm. In levels over 1,000 ppm the growth is reduced, the leaves are starting to curl (some varieties even develop cup-shaped leaves) and the colour of the plant becomes more and more dull (and in extreme circumstances, over 1,500 ppm, it seems nearly black). The crop becomes weaker and the plant activity decreases, because the plant can not breathe. The result is a so-called "water-crop", which has a disturbing effect on the transport situation in the plant. In the summer period it is not really necessary to supply CO₂, but if used, it won't cause any damage.

The best way of supplying CO₂ is by using the liquid, pure form.

Light and shading

Light is very important for Kalanchoe.

Lack of light causes a weak development of the plant, which makes it sensitive to diseases. This occurs mainly in the winter period in northern climates (Northern Europe).

A general advise is to examine the greenhouses, to see if something can be removed to give the crop extra light (plant gutters etc.).

Another solution is to install supplementary lighting in the Short Days area (See 2.2).

Too much light can also cause problems. The leaves are colouring red (anthocyanin), the flower loses its colour.

That is why in the summer period (beginning in April and ending in September) the Kalanchoe needs shading, by using shading material or chalk.

Shading is meant to reduce the light level to a - for Kalanchoe - acceptable level.

We recommend to start shading at a light-level of 60.000 lux (that is Å 230 Joules/cm² or Å 1480 Joules/sq inch).

At all circumstances noon must be included in this period. On a normal summer day in Northern Europe shading will be necessary from 10.00 - 16.00 hours.

There is another period in the year when shading is also very important. That is the period where the winter is ending and where the spring is beginning. In that period the cool, dark climate can suddenly change to a soft, bright spring climate. The crop can not handle that amount of light yet and needs to be shaded. We recommend then to shade for 2-3 hours around noon when the light-level is reaching 35,000 lux. (USA – 1 footcandle = approximately 10 lux).

2.5 Fertilization

The rate and frequency of fertilization depends on criteria such as seasonal influences, growth activity of the plant, stage of development (Long Day or Short Day period), condition of the roots, type of medium, variety demands, method of irrigation, method of fertilization. This subject is the most difficult part of the Kalanchoe culture, because every greenhouse operation has its own specificities. Concerning this and looking at the above criteria, it is hard to give recommendations and guidelines. The information which we give must be considered basic or better said, the general idea of fertilization.

In general, there are three distinct fertilization periods:

1. LD period (propagation)
2. SD period (first period until flowerbud-formation)
3. SD period (second period until flowering)

The fertilization scheme is based on the main elements N(nitrogen), P(phosphorus) and K(potash). During the first period, the propagation, a ratio of 1:1:1 is sufficient. It is important to provide fertilizer at this period to provide for future development. Until bud formation the basic ratio transfers to 3:1:3 or 4:1:4, gradually changing to 2:1:4 or 3:1:4 for the flowering period. Besides N, P and K, the Kalanchoe also needs other main elements like Ca (calcium) and Mg (magnesium). Supplemental applications of these fertilizers can be necessary. Also trace elements, particularly Fe (iron) and Mn (manganese), are necessary.

Target figures

After many analyses, comparing analysis reports and trials we were able to make a guideline of target figures in the pot, based on mili-moles and (figures shown between brackets: parts per million) and for trace elements micro-moles:

Period	PH	EC	NH4	K	NaCl	Ca
1	5.5	0.5	0.1 (1.8)	1.0 (39)	1.0 (58.5)	2.0 (80)
2	5.8	1.2	0.1 (1.8)	2.0 (78)	2.5 (146)	3.0 (120)
3	5.8	1.5	0.1 (1.8)	3.0 (117) 4.0 (156)	4.0 (234)	3.0 (120)
Period	MG		No3	SO4	HCO3	PO4
1	0.5 (12)		2.5 (155.0)	1.0 (96)	0.1 (6.1)	0.5 (47.5)
2	1.5 (36.5)		4.5 (279.0)	1.5 (144)	0.5 (30.5)	0.6 (57)
3	1.5 (36.5)		7.0 (409.5)	2.0 (192)	0.5 (30.5)	0.6 (57)
Period	FE		Zn	Mn	B	Cu
1	25(1400)		1.5 (98)	10(550)	25(270)	0.25 (16)
2	25(1400)		1.5 (98)	10(550)	25(270)	0.25 (16)
3	20 (1100)		1.5 (98)	10 (550)	25 (270)	0.25 (16)

Correcting the pH (acid level)

Extremely low (under 4): with calcium carbonate. Low (4-5): with calcium saltpeter. A little high (6-7): with ammonium-nitrate. High (7-8): with phosphoric-acid or another acid.

Recently two other analyzing methods become more and more reliable, dry matter analyses and plant juice analyses. Knowledge about the figures gained by these methods is still small, but is increasing by research, amongst others at FGB.

§ 3 PLANT PROTECTION

3.1 Hygiene in the greenhouse

Hygiene is a subject sometimes highly underestimated.

- Take out weeds in the pot or between the pots. It can attract all kinds of parasites.
- Remove old leaves or other parts of plants from the floor and the tables. Also weeds found below the tables.
- Remove affected plants (either by insects and moulds) immediately and put them in a plastic bag to destroy them.

The recommendation is to monitor your crop weekly. You can be using the Yellow or blue insect plates (1000 square foot/4 per 1000 m²), on which you can see what kind of insects are in the greenhouse and in which amount. Use as well a magnifying glass (8-10 times) for determination.

Put those plates just on top of the crop, preferably in a bend position.

Prevention can save you a lot of trouble, time and money.

3.2 What kind of diseases can we expect on Kalanchoe?

Some chemicals mentioned in this chapter may not be allowed in your country.

A. Virus

One of the major threats in Kalanchoe is virus. For many years it was underestimated, because for the grower a plant with or without virus did not show any difference on a finished plant.

But the pressure of virus was slowly building up in several varieties and they infected also several until then healthy varieties.

Propagation companies like FGB had successfully changed that development, by using as much as possible cleaning methods to get virus-free (poor) nuclear stock plants and use them for multiplying the production.

Until now at least 8 different viruses have been found in Kalanchoe. Unfortunately not all of them can be tested or cleaned yet. Visual control is still necessary.

1. Yellow Spotted Virus

This is the eldest known virus in Kalanchoe, a bacillus-for Badna-virus, that causes chlorotic rings and necrotic spots on the leaves. This virus can be transferred by seed, pollen and meristems because of that very difficult to eliminate. Even determination by Electronic Microscope (EM) is difficult and there is no testing-method. (Especially in varieties like Nugget, Yellow Nugget, Etna is the virus very expressive).

2. Kalanchoe Latent Virus (Carla Virus)

This virus does not show any symptoms, but it's proven to exist within Kalanchoe. Testing is possible, but not always reliable in result.

3. Potato-Y (Poty) Virus

The symptom of this virus is a soft mosaic-structure on the leaf. Sometimes it looks like Yellow Spotted Virus, but not so intense. This virus can be shown by EM and testing is possible.

4. Tobacco Mosaic Virus (TMV)

It has been shown in Kalanchoe, but no further information available.

5. Kalanchoe Mosaic Poty Virus ("Green Island") (KMV)

This virus shows a chlorotic, mosaic-like pattern, mostly dark-green in colour (that explains the fancy name Green Island). For a long time it was thought to be physiological stress problem, but in 1993 it was proven to be caused by a virus, for which can be tested (especially strong in Singapore types).

6. Tomato Bushy Stunt Tombus Virus (TBSTV)

The symptoms of this virus is twisted leaves and strongly curling leafmargins. This virus is mostly found in combination with KMV, mainly in Fascination types (Fascination, Charme). Testing is possible.

7. Carnation Mottle Carmovirus (CMC)

This virus is once been shown in Kalanchoe, but no details are further available.

8. Impatiens Necrotic Spotted Virus (INSV)

This virus is related to the TSWV (Tomato Spotted Wilt Virus), that can be transferred by Californian Flower Trips.

The symptoms can differ per variety and can be easily confused with damage, caused by spraying a 'forbidden' chemical for Kalanchoe, a wrong method of spraying or fertilization-damage.

In general symptoms like necrotic (light-green) spots and V-shaped formations occur. Also the leafmargins are turning yellow and later on brown (which looks like burning). Testing is possible.

Besides these 8 viruses there are a few symptoms known in Kalanchoe, from which we presume they are caused by virus, but which virus itself is unknown.

- Rough leaf-surface with a dull colour. Probably a symptom of Kalanchoe Latent Virus.
- Patterns of spots and stripes in the flowers. This can be found in different varieties, alongside several of the symptoms described above. That makes it difficult to direct it on a specific virus. It probably it is a symptom caused by several types of virus.

Testing on virus is more and more possible on virus, but to find a treatment is impossible. The only solution is to clean the plants, which is a long, tough and expensive but necessary process.

B. Bacteria

Bacteria (mainly *Erwinia chrysanthemi* and *Erwinia carotovora*) effects the inside of the plant, which becomes dull and limp. It is subsequently usually affected by moulds and dies. There is no chemical cure for bacteria during the crop.

We recommend the following procedure:

- Put affected plants in a plastic bag and destroy them immediately.
- Take care of a good microclimate (right temperature, a dry crop, as much light as possible). In case of a major infection it can help to lower the temperature to 62-64°F (17-18°C).
- Destroy after a infected culture all the material which can be removed. Material which cannot removed (tables, irrigation material etc.) must be disinfected with Formaline, Trinitriumphosphate or similar chemicals (if allowed).
- Do not work with used medium or used pots.

C. Moulds

- Mildew

- . Spots of mouldy fluff on the leaves.
- . Misforming of meristem, cork-spots.

Treatment:

- . Sulphur-evaporators (1 per 250 sq. yard/1 on 200- 250m²).
- . Spraying with Triforine or Imazalil (can cause a delay in growth).

- Botrytis

- . Rotting, wet parts with grey-black mouldy fluff.

Treatment:

- . Remove plant debris between pots.
- . Spraying with Iprodione, Thiofanate-methyl, Prochloraz, Vinclozolin, Mancozeb.
- . Dipping the cutting in one of the chemicals mentioned above.

- Rhizopus

- . On all parts of the plants light-brown, wet spots can be found. The heart of the stem is getting very hard.

Treatment:

- . Like Botrytis.

- Pythium, Phytophthora, Fusarium

- . All these moulds affect the place of the stem which is just above the ground. In the end the plants will fall down.

Treatment:

- . Use healthy soil, do not use too much water.
- . Mix Etridiazole, Chlorthalonil or Maneb/Metiram through the soil.
- . Water with Furalaxyl, Fosethyl-aluminum, Thiofanate- methyl, Prochloraz, Iprodione, Benomyl.
- . Spray with Chlorthalonil-maneb, Benomyl, Thiofanate-methyl, Propamocarb-hydrochloride (only once, can cause damage) or Dimethomorph (only for Phytophthora).

- Cylindrocarpon, Cilindrocladium
- . On the stem-base there are black, hard spots Cylindrocladium to see, as like Pythium, but instead of wet they are dry.

Treatment:

- . Like Pythium. (Prochloraz is the most effective chemical).

- Phoma, Rhizoctonia

- . In the top of the plant rotting orange-brown or black spots are visible. The plant can collapse in a few days.

Treatment:

- . Keep the crop as dry as possible
- . Spray with Thiofanate-methyl, Chlorothalonil maleb, Iprodione, Benomyl or Propamocarb hydrochloride.

- Myrothecium rodidum

- . Black-brown slimy spots on the wound after rodidum pinching or on the leaves.

Treatment:

- . Make sure that temperature is not too high. (not more than 20°C), especially not with a wet crop. Keep humidity under 90%.
- . Spray with Chlorothalonil-Maneb or Carbendazim.

- Chalara elegans

- . The roots of affected plants are showing brown spots, later the whole root-system gets brown, causing wilting.

Treatment:

- . Keep the crop as dry as possible.
- . Spray and watering with Thiofanate-methyl or Carbendazim.

D. Animal parasites

- Mites (Tyrophagus spp. and Tarsonemus pallidus) are small orange-brown-black insects, which can be found in the top of the plant, destroying the young parts of the plant (misforming).

Treatment:

- Spray with Fenpropathrin, Permethrin, Fenbutatin-oxide, Abamectin, Oxamyl, Pyridaben or Bifenazate (sensitive for resistance). Other chemicals (like Parathion, Triazofos, Pirimifos- methyl and Endrin) give a lot of damage, but when plants are heavily affected they can be useful.

- Aphids (Aphidoidea) are green-yellow insects, which causes misforming of the leaves and the flowers. They can also carry viruses. Recently a red aphid is known to exist, which is more difficult to treat than the green-yellow one.

Treatment:

- Spray with Pirimicarb, Oxamyl, Methomyl, Esvenvalaraat, Carbofuran or Heptenofos.
- Dripping with Imidachloprid (resistance sensitive),

- Cotton-Aphids are reddish insects, which causes the same problems as usual Aphids. They are however not so easy to treat as the normal Aphids. Treatment: See Aphids.

- Mealy bugs and scale insects (Pseudococcus maritimus and Aspidiotus hederae) are flat, white-pink insects, which damages the plant just as like Aphid. Both are difficult to treat.

Treatment:

- Spray with Oxamyl, Imidachlopid (resistance sensitive), Pymetrozine, Mevinfos (can cause damage) or Pirimos-methyl.
Before using the chemical the advise is to spray with a wedding agent. These chemicals resolves the wax protection of the insect. This must be used with care, because the Kalanchoe also has a wax layer on the leaf.
- Dripping with Imidachlopid (resistance sensitive).

- Root Aphids (Trama troglodytes) are white insects, which damages the roots.

Treatment:

- Spray with Imidachlopid (resistance sensitive) or Mevinfos (can cause damage).
- Dripping with Imidachlopid (resistance sensitive).

- Soil Aphids are green-grey insects, with a red backbody which damages the roots.

Treatment:

- Spray with Imidachlopid (resistance sensitive), Mevinfos (can cause damage).
- Dripping with Imidachlopid (resistance sensitive).

- Caterpillars (Pieris, Plusia, Mamestra species) cause physical biting damage.

Treatment:

- Spray with Trichlorfon (can cause damage), Permethrin, Flucycloxuron, Methomyl powder, Esfenvalaraat, Bacillus thuringiensis (watering treatment), Methomyl (preventive), Teflubenzuron, Fenpropathrin or Diflubenzuron. Use a lot of fluid to spray.

- Duponchelia (fovealis)

The caterpillar of this little brown moth, which has a lengtened backbody (tail), causes a lot of problems in the underpart of plant, just on the soil. They are difficult to treat, because they are hard to reach.

Treatment: see Caterpillars.

- Beet Armyworm (Spodoptera exigua)

This caterpillar is about 3 cm big, has a yellow stripe at the side and a black spot on every segment. They cause eating-damage on the plant.

Treatment: Spraying with Nucli polyedevirus (use a lot of fluid and during 14 days the treatment must be repeated 3-4 times).

- Spraying with: Teflubenzuron, Flycyclozuron or Diflubenzuron.

- Leaf roller (Tortricidae) rolls up leaves, like caterpillars.

Treatment:

- Spray with the same chemicals as used for caterpillars, but also with Deltamethrin or Cypermethrin.

- Black Vine Weevil (Otiorynchus sulcatus or O. singularis) are big (5 mm/0.15 inch) insects, black/brown, which affects leaves, stems and flowers (biting damage).

Treatment:

- Spray with Pirimifos-methyl.

Treatment of the larva:

- Mix Carbofuran through the soil or spread on plant surface.

- Centipede (Scutigera immaculata) is a little white insect, which damages the roots.

Treatment:

- Mix Carbofuran through the soil or spreading on surface.

- Fungus Gnats. The larva (3-4 mm/0.1 inch) damages the roots, especially of cuttings that have just been stuck.

Treatment:

- Mix Carbofuran through the soil or spreading on surface.
- Spray with several liquid-formulations or water with Diflubenzuron, Triazofos (can cause damage), Permethrin, Methomyl or Deltamethrin.
- Working with biological agents in the soil have a better result than chemical treatments.

- Thrips (Frankliniella occidentalis) is a 3-4 mm (0.1 inch) insect, which causes damage in the top of the plant (young parts) and hardly not on the finished plants. Especially in motherplants extremely dangerous, because of the spreading of INSV virus (see Virus).

Treatment:

- Spray with Oxamyl, Abamectine, Spinosad (resistance sensitive), Methiocarb, Deltamethrin, Permethrin, Methomyl, Dichlorvos.

- Red spider mite (Tetranychidae) is a small red-brown-yellow spider like insect. Very rare in Kalanchoe.

Treatment:

- Spray with Dienochlor or Fenpropathrin.

- Greenhouse White fly (Trialeurodes vaporariorum) can cause damage by producing honeydew, which can attract moulds.

Treatment:

- Spray with Permethrin, Cypermethrin, Deltamethrin, Oxa myl or Fenpropathrin.

- Snails (Mollusca)

Treatment:

- Surface spreading of methiocarb or mercaptodimethur.

- Leafminer-fly (Liriomyza species). Especially the *L. huidobrensis* can cause damage in Kalanchoe, although it is rare. On the leaves you see short, thick mines, in which the larvae exist. Most sensitive are the Bell-flower (Hanging) Kalanchoes.

3.3 Tips for Plant Protection

With regard to using chemicals, take care of the following:

- Read very carefully the instructions on the chemical, especially regarding to safety and treatment rates.
- Make a preventive scheme as the first priority, with chemicals which have effect on more diseases.
- Do not use liquid chemicals, except when recommended safe.
- Do not use chemicals as dusting-powder. Kalanchoe is extremely sensitive to dusting powders.
- Do not use chemical carriers when using a fogger. Use only water as a carrier.
- Do not use chemicals in a cocktail; but if necessary, never more than two chemicals together.
- Do not use Alar or Bonzi or other growth-regulators with chemicals.
- Do not use heavy chemicals like Methiocarb or Methomyl in the winter on the Northern hemisphere (Northern Europe).
- A lot of chemicals can cause residue on the plant (leaf). Many times this is caused by a bad solving of the chemical or too high pressure of the spraying equipment or spraying too close to the plant. With a treatment of a wedding agent (20-30 cc on 100 litre of water) the plant can be cleaned (be careful, this treatment can cause damage). A second possibility is spraying with citric acid (10 gram on one litre of water).
- All kinds of treatments to clean the plant of residue have to be followed by a treatment with clean water.
- In case of using biological agents, do not use wedding agents.
- If you doubt a new chemical, do a trial or spray on a 50- 75% rate (so instead of 100 grams, 50 to 75 grams).
- Try to avoid spraying in the last period of the crop, when the buds are showing colour, it can causing flower-damage.
- Do not spray on a flowering crop.
- Do not use time after time the same chemical. Change this with another chemical to avoid resistance.
- Take care of a good hygiene and a good crop control (scouting), together with a healthy climate. Then you do not have to use the chemicals list very often.

3.4 Tables

Table I Fungicides

Trademark*	Active Chemical*	Rate	Treatment	Pre-Ven-tive	Cu-Ra-Tive	Cock-Tail	C* S*
AA Terra	Etridiazole 35%	250 g/m ³	Soil	X	-	-	S
AA Terra		250 g/100 l	Spraying	X	-	-	S
Aliette	Fosethyl-Aluminium 80%	250 g/100 l	Spraying	X	-	-	S
Aseptia-Funginex	Triforine	75 cc/100 l	Spraying	-	X	-	S
Bavistin	Carbendazim 50%	200 g/100 l	Spraying	-	X	-	S
Curamil	Pyrazofos 294 gr/l	30 cc/100 l	Spraying	-	1 x	-	S
Daconil	Chlothalonil 500 gr/l	200 cc/100 l	Spraying	X	X	-	C
Daconil-M	Chlorthalonil-	250 g/m ³	Soil	X	-	-	C
Daconil-M	Maneb 25+50%	200 g/100 l	spraying	X	-	-	C
Derosal	Carbendazim	100 g/100 l	Spraying	X	-	-	C
Dithane M45	Mancozeb 80%	300 g/100 l	Spraying	-	X	-	C
Fongarid	Furalaxyl 25%	100 g/100 l	Spraying	X	200	X	S
Fongarid		150 g/100 l	Watering	X	x	-	S
Fungaflor	Imazalil 200 gr/l	75 cc/100 l	Spraying	X	100	X	S
Paraat	Dimethomorph	10 gr/100 l	Watering	X	100	-	S
Polyram Combi-M	Maneb-Metiram	250 g/m ³	Soil	X	-	-	C
Previcur-N	Propamocarb-H 722 gr/l	100 cc/100l	Spraying	-	1 x	-	C/S
Rizolex	Toclofos-Methyl	100 g/100l	Spraying	X	X	-	C
Ronilan	Vinclozolin 50%	50 g/100 l	Spraying	X	X	-	C
Rovral	Iprodione 50%	250 g/100l	Spraying	X	X	X	C
Rovral		200 g/100 l	Watering	x	x	-	C
Sporgon	Prochloraz 46%	100 g/100 l	Spraying	X	X	-	S
TMTD	Thiram 98%	300 g/100 l	Spraying	X	X	-	C
Topsin-M	Thiofanate-Methyl 70%	100 g/100 l	Spraying	X	X	-	C
Topsin-M	Thiofanate-Methyl 500 gr/l	300 cc/100 l	Watering	-	X	-	C
Sulphur-Evaporators	Sulphur 100 %	1 per 200-250 m ²	Evaporating	X	-	-	

Table II Insecticides

*C= Contact-chemical *S= Systemic-chemical

Trademark*	Active Chemical*	Rate	Treatment	Pre-Ven-tive	Cu-Ra-Tive	Cock-Tail	C* S*
Actellic	Pirimfosmethyl 500 gr/l	50 cc/100l	Spraying	X	1x	-	C
Admire	Imidacloprid 70%	10 g/100 l	Spraying	-	1x	-	C
Admire	(resistance possible)	3.5 g/1000	Dripping	-	1x	X	C
Ambush	Pemethrin 250 gr/l	25 cc/100 l	Spraying	X	50	X	C
Andalin	Flucycloxuron 25 gr/l	100 cc/100 l	Spraying	-	X	-	C
Applaud	Buprofezin 25 gr/l	100 g/100 l	Spraying	X	-	-	C
Aseptacarex	Pyridaben	70 cc/100 l	Spraying	-	X	-	C
Aztec	Triazamaat	100 cc/100 l	Spraying	-	X	X	CS
Conserve	Spinosad (res.sensitive)	75 cc/100 l	Spraying	-	1x	x	C
Curater liq.	Carbofuran 200 gr/l	100 cc/100 l	Spraying	-	X	-	S
Curater	Carbofuran 5%	200 g/m ³	Spreading	X	X	-	S
Cymbush	Cypermethrin	50 cc/100 l	Spraying	X	X	-	C
Decis	Deltamethrin 7.5 gr/l	50 cc/100 l	Spraying	-	X	-	C
Dimilin	Diflubenzuron 25%	40 g/100 l	Spraying	X	X	-	C
Dipterex	Trichlorfon 80%	125 g/100l	Spraying	-	X	-	C
Dipterex	Trichlorfon 80%	125 g/100l	Spraying	-	X	-	C
Floramite	Bifenazate (res.sensitiv)	40 cc/100 l	Spraying	-	1x	X	C
Hostaquick	Heptenofos 550 gr/l	50 cc/100 l	Spraying	-	1x	-	C
Kilumal	Fenpropathrin 100 gr/l	500 cc/100 l	Spraying	X	X	-	C
Kilval	Vamidothion 400 gr/l	100 cc/100 l	Spraying	X	X	-	C
Lannate	Methomyl 25%	100 g/100 l	Spraying	X	X	X	C
Luxan D	Dimethoat 440 gr/l	500 cc/100 l	Spraying	-	X	-	S
Mesurool	Methiocarb 40 %	30-50g/100 m ³	Spreading	X	X	-	C
Mesurool liq.	Methiocarb 500 gr/l	100 cc/100 l	Spraying	-	X	-	C
Metasystox	Oxy-demeton-methyl 250 gr/l	100 g/100 l	Spraying	X	-	-	S
Methomex	Methomyl	125 cc/100l	Spraying	x	X	X	C
Nomolt	Teflubenzuron 150 gr/l	100 cc/100 l	Spraying	X	X	-	C
Parathion	Parathion 250 gr/l	100 cc/100 l	Spraying	X	1x	-	C
Pentac	Dienochlor 50%	75 g/100 l	Spraying	X	X	X	C
Phosdrin	Mevinfos 145 gr/l	75 cc/100 l	Spraying	X	X	-	C/S
Pirimor	Pirimicarb 50%	50 g/100 l	Spraying	X	X	X	C
Plenum	Pymetrozine	40 g/100l	Spraying	-	X	X	C
Spod-X	Spodoptera exigua Nucli-polyedevirus	50 cc/100 l	Spraying	-	X	X	C
Sumicidin	Esfenvaleraat 25 gr/l	100 cc/100 l	Spraying	X	X	-	C
Talstar	Bifenthrin 100 gr/l	40 cc/100 l	Spraying	X	2x	X	C
Torque Plus	Fenbutatin-Ox 50%	50 g/100 l	Spraying	X	X	-	C
Turex	Bacillus thuringiensis	75 cc/100l	Spraying	x	X	x	C
Turex	Bacillus thuringiensis	75 cc/100l	Watering	x	X	x	C
Vertimec	Abamectine 18 gr/l	50 cc/100 l	Spraying	X	X	X	S
Vydate	Oxamyl 250 gr/l	250 cc/100 l	Spraying	-	X	X	C/S
Vydate		20 cc/100 l	Dripping	-	X	-	C/S

Table III
Disinfectants, etc. (not on the plants)

<i>Trademark*</i>	<i>Active Chemical*</i>	<i>Rate</i>	<i>Treatment</i>	<i>Pre-Ven-tive</i>	<i>Cu-Ra-Tive</i>	<i>Cock-Tail</i>
Formaline	Formaline	10 l/100 l	Spraying	-	X	-
Menno ter Forte	Didecyldime-Thylammonium-Chloride 320 gr/l	200 cc/100 l	Spraying	-	X	-
Trinatrium-Phosphate	Trinatriumphosphate	100 cc/100 l	Spraying	-	X	-
Kalamid	Kalamid	100 g/100 l	Spraying	-	X	-

Table IV
Others (growth-inhibitors/spreaders, etc.)

Trademark*	Active Chemical*	Rate	Treatment	Pre-Ven-tive	Cu-Ra-Tive	Cock-Tail
Alar	Daminozide 64%	4 g/1 l	Spraying	X	-	-
Dazide	Daminozide 85%	3 g/1 l	Spraying	X	-	-
Cycocel	Chloormequat 457 gr/l	1 cc/1 l with Alar or Dazide	Spraying	X	-	X
Bonzi	Paclobutrazal 4 gr/l	0,1-2 cc/1 l	Spraying	X	X	-
Reducymol	Ancimydol	0,5-1% (3 l/m ²)	Form under-Neath	X	-	-
Topflor		25-50 cc/1 l	Spraying	X	-	-
Atrinal	Dikegulac-nat	5-7,5 cc/1 l	Spraying	X	-	-
BA	Benzyladenine	50-100 ppm	Spraying	X	-	-
Berelex ga 3	Gibberella-Acid	Dependent	Spraying	-	X	-
Agral LN	Nonylphenol-Polyglycolether	20-30 cc/100 l	Spraying	-	X	-
Citric acid		100 g/1 l	Spraying	-	X	-

*) These trademarks might not be available in all countries.

***) These chemicals might not be allowed in all countries.

3.5 Biological Control

In general Kalanchoe is a crop where diseases not often reaching a stadium of a pest. On the other hand there is a sensitivity for several, mainly liquid, chemicals. This opens possibilities for biological control.

The information we can offer is however basic, because there are many specialists on this subject. Also FGB has a specialist on working with biological control, which can be reached by your contacts inside Fides or FGB.

The most important rules to follow in case of using biological control:

- It is important to work preventive with biological agents.
- It is of great importance that the attacker and the stage of the attacker are identified, in order to choose the right biological agent.
- The succes of biological control depends on a good scouting system. At least once a week the crop has to be checked (signalplates), in order to discover an attack in an early stage. This leads to a controled system, in which the attack and the respons of the biological agents can be followed easily, and when an attack gets out of control, actions are taken in time.
- Depending of the time of the year and the sensitivity of varieties for certain attackers, a preventive program can be obtained. This means introduction of biological agents on a regular basis (1-6 weeks).
- In case an attacker is found or increases in numbers, a curative program can be started, which means introduction of larger numbers of biological agents, more frequently, but also other species.
- Next to using biological agents there are possibilities of using chemicals, which have hardly or no impact at all on the biological agents.
- Sulphur evaporators, a necessity in the culture of Kalanchoe, can have a negative effect on the biological agents.

§ 4 PROBLEMS IN THE KALANCHOE CULTURE

4.1 Symptoms / Trouble Shooting

In this chapter we describe a number of symptoms, which can occur in the culture of Kalanchoe. Next to that symptom we tried to make a list of possible causes. We do not pretend however that we have all the solutions possible. If you know other solutions to a problem, do not hesitate to inform us about it.

a. Cutting/Plant becomes yellow

Plant or cutting becomes lighter, yellow to brown, with rotting spots and dies.

Cause:

- cutting is too old
- damage chemicals
- nutrient level (EC) too low
- too much additional light at day (assimilation light), + 18 hours

b. Stop/Delay in growth

Growth of the plant slows. Vegetative development stays behind in comparison to the flowering parts.

Cause:

- nutrient level is too high (+ 4 EC)
- standard of nutrient elements (N, Zn) is too high
- too early in the SD (not enough LD)
- too high rates/applications of growth retardants
- too much CO₂ (+ 1500 ppm)
- temperatures below 15°C (60°F) (than also a big chance of not flowering)
- too heavy treatment with chemicals or use of wrong chemicals
- virus

c. Rotting

Rotting parts can arise on every variety in any colour.

Cause:

- moulds or bacterial affection

d. Withering

Plant gets dull in colour, becomes weak and can start to rot.

Cause:

- lack of water
 - beginning of a bacterium or mould affection (especially those which attack the vascular bundles)
 - roots are dying. Especially in springtime. After a period of dark/cold weather a period of warmer/sunny weather comes in. Reaction is than extra irrigation, but the roots are not strong enough to handle that extra water and die

e. Growing together of shoots and flowers

Two or more stems or flowers are grown together as one. Cause:

- too high (hot) temperature (summer)
- stress as a result of a too high fertilization level
- genetic variety characteristic

f. Residue

On the plant, usually on the leaves, white-grayish spots/areas can be found.

Cause:

- irrigation water polluted
- irrigation water contains high levels of chemicals, for instance well-water with a lot of carbonates
- granulation of fertilizers
- fertilizers or chemicals are not enough solved in the water before application.

g. Cork spot on stem

On the stem or the flower stem, corky parts can be seen.

Cause:

- mildew infection
- damage caused by a chemical

h. Misforming of shoots (meristem)

The head of the plant develops slowly and the new formed leaves, shoots, flower stems and flowers are damaged. At worst, the top dies.

Cause:

- insect infection (mite, aphid) always "cork"-forming on affected parts
- use of wrong chemicals
- damage from chemicals like Atrinal or too high rates of Bonzi
- for too long too much water on the plant
- mildew infection

i. Red leaf

The edge and/or the centre parts of the leaf turn(s) red.

Cause:

- light intensity too high (too long above 60.000 lux)
- culture too cold (under 17°C)
- culture too dry
- stress as a result of heavy spraying, which causes stop of growth
- variety characteristic

j. Leaf dropping

In any stage, the leaves suddenly can fall.

Cause:

- root system or part of it has died (a lot of black and brown roots and many hair roots are formed)
- infection by sciarid, heavy affection of moulds or insects
- treatment with wrong chemicals (especially dust chemicals)
- too long a high humidity (+90%) with a weak crop

k. Burned parts

The edge and/or other parts of the leaf show(s) burned spots.

Cause:

- damage by (liquid) chemicals
- sun glass effect
- fertilizers, which are not well dissolved after irrigation
 - root system or part of it has died (a lot of black and brown roots and many hair roots are formed)
 - virus (TSWV, INSV)

l. Yellow leaves

Edges and/or parts of the leaf turn yellow.

Cause:

- use of the wrong chemicals
- first symptoms of a weakening root system, mainly followed by leaf-dropping
- lack of main elements (N, P, K, Ca) or trace elements
- too long a high humidity (+90%) with a weak crop, mainly followed by leaf-dropping
- too high or too low pH (acid-level, <4 or >7)

m. Leaf spots

Yellow or brown spots appear on the leaf.

Cause:

- genetic (e.g. with orange varieties)
- virus (yellow, necrotic spots)
- stress (growing conditions are far from optimum, especially too high or low pH, too high EC (+3,0), too much water)
- first symptoms of dying of the roots)
- evaporation-damage (wet, grey spots)

n. Bulging leaf

Leaf is bulging more and more and forms a cup shape.

Cause:

- infection by mildew (leaves are rough and dull in colour), leaf rollers/caterpillars
- reaction at unfavourable climate circumstances (too cold or too hot with bad evaporation)
- too high in Nitrate-levels
- too high CO₂ (+ 1200 ppm). In that case some varieties show real cup-shaped leaves.
- variety characteristic

o. Clock-shaped leaf

Leaf is misformed and has the shape of a clock/bell.

Cause:

- too high CO₂ rate (> 1200 ppm)

p. Curly leaf

The edges or the whole leaf starts curling.

Cause:

- virus (TBSTV/KMV)
- variety characteristic

q. Leaf blisters

Dark-green blisters arise on the leaves.

Cause:

- 'growing-pains'. Occurs on young plants with a strong growth activity, but with low supply of feeding (the roots cannot keep up)
- Virus (KMV/Green Island)

r. Rough leaf surface

Surface of the leaf gets dull and rough.

Cause:

- damage of chemicals
- virus
- at the underside of the leaf it can mean the start of mildew

s. Leaf deformation

Leaf doesn't have a normal shape.

Cause:

- infection by aphids, mite, thrips, caterpillars and snails
- use of wrong chemicals or too high rates
- stress because of wrong growing-conditions, instable micro-climate (fluctuations in temperature and humidity), too wet

t. 'Black' leaf

Colour of the leaf is very dark green and looks 'black'.

Cause:

- CO₂ and/or Ethylene poisoning
- too much zinc (Zn)
- too high fertilizer level (EC >4-5)
- too high CO₂ level, above 1500 ppm

u. Leaf warts (cam)

On the midrib of the leaf misforming can occur, little or bigger proliferations. Cause:

- variety characteristic, which can be influenced by stress, caused by wrong growth-conditions, like evaporation-problems, too luxuriant growth
- stress as a result of a cultural problem (such as high EC or pH, low EC or pH)

v. Drying out of flower buds/not opening of flowers

In the stadium of opening the flower seems to stop that process, the buds do not develop as well are drying out.

Cause:

- too late treatment with too much Bonzi
- too much water (moisture) between the flower heads (last stadium of finished plant)
- use of wrong chemicals or too high rates

w. Flower damage

The flower shows burning spots, wet spots, stripes etc.

Cause:

- see chapter 4.2
- use of wrong chemicals or too high rates
- too high light intensity
- infestation by insects
- virus

x. Bracting

The head-bud(s) is staying behind, while the side-buds (or shoots) have a uncontrolled growth. Or the plant is changing in a generative period over to a vegetative period.

Cause:

- too low temperature in the SD (below 15°C)
- too high temperature (above 32°C day or 25 at night)
- too short period of SD
- too much light in the SD-area (not dark enough)
- season influence, for instance too many dark days in the winter

y. Thorn Flowers (Choripetalie)

The flowers are broken, sometimes only an opening between two flower-leaves, going on in the flower tubes, but also the complete flower is broken on all sides. (Especially a problem in the hanging types).

Cause:

- too high light-intensity (summer)
- major temperature fluctuations inside a day
- luxuriant growth
- use of wrong chemicals or too high rates

4.2 Flower damage

Flower damage is a problem which can cause a serious loss. Affected plants lose their market value. Flower damage or the black/white flower problem was in the past a major problem, especially in red varieties. However, it also can occur in other colours/varieties.

Research proved to be necessary but it turned out to be a very complex problem, which lead to more questions than answers.

Basically there are 3 symptoms:

1. Tops and edges of flower petals are white and/or black coloured.
Arises during periods of strong growth, but with rapid climate changes. The crop becomes inactive and is not capable of a good transport of nutrients, especially to the parts of the plants where it is mostly needed.
That is where weak cellwalls occur, caused by a lack of cal-cium, especially in stretching parts. This causes bursting of cells in the end.
2. Parts of the flower or the complete flower shows waxy parts. This can also get into the buds, young shoots and flower stems.
When a speedy growth goes along with a low nutrient level (EC), a high humidity (especially in the night) and a hightemperature, the root-system will be over-active, which causesextra water-transport in the plant. Because of the inabilityto evaporate (high humidity), the pressure between the cellsbecomes higher, which causes rupture of cell walls.
3. On the flower leaves are white/brown/black spots, sharply circled.
This is a non-physiological problem, caused by crops, which are too wet for too long. Especially with overhead irrigation. It can also be caused by pest control (spraying chemicals).

The key to the problems 1 and 2 is the EC. When the EC (especially the calcium level) is too low, you can expect problems.

Therefore our main recommendation is at least 1.5 EC after approximately 6 weeks in the Short Day period.

Besides that, there are three important topics:

Temperature: Must be as steady as possible and must not fluctuatetoo quickly. Therefore the 68-68°F (20°-20°C) day-night temperature appears to be best. Minor adjustments of 1 or 2 degrees will not do any harm.

The fall down in temperature when opening the screen, can be avoided by a raise of the temperature. Too high temperatures can be avoided by ventilation or by opening the screen a little bit (1-2 m/1-2 yards). (See chapter 2.4.)

Humidity: The humidity must be fairly constant as well (70-80%), without too many fluctuations. If the temperature fluctuations can be prevented, it also will help the humidity level.

Prevention of moisture damage: Keep the crop as dry as possible. If possible, do not irrigate overhead and/or do not spray at the end of culture. (If necessary it is recommended in the morning, so the crop can be dry entering the night.)

A summary of attentions for this extremely difficult problem.

- Take care of a good EC level (minimum 1.5).
- Take care that this EC is reached 6 weeks before flowering.
- Take care of a high enough Ca level.
- Take care of the right nutrient balance of Ca-K-Mg.
- Be sure the plant is day and night active. A resting period of a couple of hours at the beginning of the night is not a problem.
- Take care of a constant temperature-regime. Extreme fluctuations are dangerous.
- Take care of a constant humidity-regime. Also here extreme fluctuations are dangerous, although they are more come as by temperature. (70-80% is ideal, below 65 and above 85% can cause problems.)
- Take care that the crop is dry.
- At least be sure that when it enters the night (screens closed), that it's as dry as possible.
- Take care that the culture can develop as normal as possible. Pushing the culture must be avoided.

§ 5 CULTURE (Other crops)

5.1 Hanging Kalanchoe culture

Next to the standard Kalanchoe culture, there is the culture of hanging types, using varieties developed from the species Bryophyllum and Kitchingia, and recognizable by the bell or clock flowers (hanging).

- The varieties (and species) used for hanging Kalanchoes can be divided by habit in two groups:
- Real hanging types, like Shinano and Tessa.
- Standing/hanging types, like Azumi and Wendy, which a vegetative growth as blossfeldiana, but with bell-flowers.
- The cuttings used for hanging Kalanchoe are from motherplants. The production is in mostly higher, because of the highly branched plants and long shoots. The cuttings used can be top- or node-cuttings.
- In the LD-period you need basically the same conditions as the blossfeldiana Types. The difference is that it takes longer (how much longer depends on the variety), overall it needs less water and there's a greater sensitivity for moulds (cutting is small and fairly soft).
- The medium can be the same as used for normal Kalanchoes.
- As by normal Kalanchoes the possibilities of pots and saucers, which can be used, is great, all depending on variety, time of the year and the wish of the grower (concerning plant size and form).
- The total croptime is also depending on a lot of influences and requirements, but normally between 15 and 20 weeks.
- To pinch or not to pinch is depending on the same conditions written by the normal Kalanchoe.
- Growth-retarders for real hanging-Kalanchoe are normally not necessary, but for the standing/hanging types it can be a choice (or a necessity).
- Fertilization, lighting, black-out, humidity, CO², response time are all, like normal Kalanchoes, depending on a wide range of conditions/requirements.
However, the major influence is the variety. The difference between the varieties is larger.
- Irrigation is a special subject in these types. In the beginning of the culture it need hardly no water. This has a positive effect on the root-system, plant-growth (compact) and the induction of the flowers. Towards the flowering period it can be given more water, but still not too much. (Especially the root-system is sensitive for too much water).
- Also a big difference is the temperature. Especially the botanical varieties needs in the SD-period at night a temperature of 50-60°F (10-14°C). The eldest varieties can be grown until 64°F (18°C). The most recent varieties (for example the Fanny Bells) can be grown until 70°F (21°C).
Higher temperatures has a negative effect on the growth and flowering of the plant.

- Light is as important as by normal kalanchoes, but also on this topic there are some major differences.
Most of the varieties needs the light for growing, because the growth is slow. But the light might also have an effect on the leaf (yellow spots at high light-intensity). Also for the colour of the flowers the light is a necessity.
- Plant-protection and hygiene are of course just as important.
These hanging varieties are more sensitive for Trips, Virus and Leafminer.

5.1.1 Fanny Bells

The Fanny Bells series is developed from varieties that are mentioned in the previous chapter. Although a lot of characteristics (or cultural requirements) are the same, there are a few major differences. With the Fanny Bells the development of the hanging Kalanchoe made a major step forward. The quality has improved significantly.

The varieties are more uniform, rich in flowering, the keeping quality is improved and the flower colour can be kept clear, even with higher temperatures. The response time is shorter, which also has an influence on the total croptime. The development of the Bells is based on the possibility to grow them together with the normal Blossfeldiana Kalanchoes, but the product is so different from the standard Kalanchoe, that specific cultural measurements must be considered.

Long Days - The LD phase takes longer than the Blossfeldiana types. The period is depending on the used potsize, but generally spoken it takes about twice as long.

Short Days - That is the same as standard Kalanchoe.

Rooting - The rooting-period takes longer than the standard Blossfeldiana, about 3 weeks. (See Long Days).

Medium - The medium used can be the same as normal.

Pots and Sizes - The choice of the grower.

Quantity per m² - The choice of the grower.

Croptime - Because of the longer LD period the total croptime will take longer. The response time of the Bells is comparable with the standard Kalanchoe. It depends however on the potsize how much longer.

Pinching - It is recommended to pinch the cuttings at the time of entry SD or 1-2 weeks before. This also depends on the choice of potsize and the growers requirements. When node-cuttings are used pinching will be a choice.

Growth Reduction - That is not necessary, but again the required plantsize is important. If a growth retardant is used, the same treatment as for the standard Kalanchoe counts.

Fertilization - In basic the same schedules can be maintained as for standard kalanchoe. However, the Bells are more sensitive for sudden changes, so there are a few things to be aware of:

- Keep the balance as level as possible, that means a 1:1:1(2:1:2) N-P-K balance during the total croptime is good.
- The EC to work with is depending on environmental conditions, but give depends on the circumstances, but in general 1,3 - 1,6 EC will be sufficient.
- Avoid great extremes of EC and pH in the pot. That means that the EC in pot must range between 0,8 and 2,3. The pH between 5,0 and 6,2.
- Kalanchoes are responding to high temperatures, and the Fanny Bells are no exception. They respond even more. Also because of the extreme humidity (25-95%) the growth-activity is reduced and as a result of the N-level is rising high. That can cause problems in the beginning of the culture (burning of the cuttings) and later on flower problems (flower-buds get burned, flowers don't come out or will be malformed).

Irrigation - The Bells are not so tolerant to water than the standard Kalanchoe. Too much and too less water causes major problems in the root-system, which means cultural problems.

Temperature - Normally they can have to same temperatures as the standard Kalanchoe. In periods of hot weather problems will occur with bud-formation, when the night-temperatures are over 76°F (24°C).

Humidity - That is really a problem in hot weather conditions, especially when it's extreme (20-100%) inside 24 hours. The best recommendation is to avoid that by giving extra water over the top during the day-period to balance the humidity, anyway to make the extremes more acceptable (50-90%).

Light and shading - In general the Fanny Bells respond different to light than standard kalanchoe. In the Long Days period they need the light for growth, but at the same time they are sensitive for too high intensities, which causes leaf-spots (burned) and even dropping the leaves. The choice between shading or not shading is difficult to make. Later on in the culture shading is necessary when the light level reaches 40.000 lux. When shading is too late or not sufficient enough, it will cause thorn flowers.

Diseases - No differences compared to the normal Kalanchoe, perhaps a bit more sensitive for thrips.

Chemicals - Spraying Bells with chemicals there can be more damaging than on standard Kalanchoe. We recommend to be very careful with spraying and check FGB or your local adviser first. Liquid chemicals causes damage on standard Kalanchoe, on the Bells they are destructive.

5.1.2 Mirabella

The most modern Bell type is the Mirabella, bred by Thomas Frank in Denmark. A lot of cultural issues, as spoken of in previous chapters, also can be used in the Mirabella culture.

However, a few of them are highlighted.

-Different potsizes can be used. The amount of (node-)cuttings depends on the potsize and the size of the cutting. For instance in a 4 inch (10,5 cm) pot you require 5 small or 3 big cuttings.

-The LD period depends on potsize and required plant type/form. In case of 4 inch (10,5 cm) pots it needs 6-7 weeks. The SD period (response time), depends on the season, is 12-15 weeks.

-Pinching can be a necessity. Shortening the plants might be a better word.

-Keeping the crop compact can be obtained by growth retardants, but also by drying out the crop.

-Ideal temperature is 64-68°F (18-20°C.)

5.2 Lucky Bells

The culture of the semi-botanical Kalanchoe 'Lucky Bells' is one of the most difficult crops in Kalanchoe world. The plant has a totally different growth. Temperature, shading, soil-requirements are basically the same as the normal Kalanchoe culture.

The potsize to use is of course the choice of the grower, but the advise is 4-5 inch pots (10-12 cm) with 2 cuttings (25-30 pots per m²/19-23 pots per sq. yard). The required planthight is approxamately 40 cm (13 inches.)

To make a succes of this crop the following procedure must be maintained, which is based on present knowledge so far:

1. Long Day/rooting period: 4-5 weeks. Like standard Kalanchoes.
2. In the 3d and 4th week of the Long Day a normal treatment with a retardent (f.i. Alar/B-Nine/Bonzi).
3. Pinching: Last week of the Long Day.
4. Short Day Period: a least 7-8 weeks without break.
5. In the first week of the Short Day: A treatment with Berelex (Gibberalinen GA3) and a retarder in one cocktail. Rate Berelex: ¼ tablet on 5 Liters of water. (Alar/B-Nine/Bonzi standard rate).
6. If necessasry: repeat step Nr. 5 in the 2d week of Short Day.
7. After that (if necessasry): weekly treatments with Alar/B-Nine/Bonzi.

Gibberalinen are necessasry to induce the flowering, but causes at the same time a weak, stretched stem. That's why at the same time a treatment with a retardent is necessary, because that will prevent the stretching, improves the strength of the stem and does not influence the flower-induction.

5.3 Botanicals (Foliage plants) culture

This is another culture of Kalanchoe, where botanical varieties are used, not for flowering potplants, but for foliage plants. A few of the botanical species are very suitable for this form of culture.

Nearly all culture-measurements, as described in this guide, can be used for this culture. Because of the variation between these botanical species adjustments to this culture-measurements are very specific and therefore it is not easy to publish an advise.

Of course it is the choice of the grower which potsizes to use, but the advise is to use 12cm (5 inch pots), with the preference for terracotta claypots instead of plastic pots.

5.4 Mini and Midi Culture

A major part of the culture of the Kalanchoe are the small pots, (for potsizes see Chapter 2.1) the so-called Mini (very small) and Midi Culture.

- Normal varieties can be used for these cultures, but also there are more and more specific mini-varieties.
- The cuttings used for this culture need to be smaller than for a standard culture. Specific mini-varieties naturally produce smaller cuttings, but for standard varieties it is necessary to pick them smaller.
- The rooting takes just as long as for the bigger pots, but because of the smaller pots, the required plantsize is reached quicker, which means that the crop can enter the Short Days earlier. This means that the LD period is shorter.
- The medium can be the same, but may be more fine in structure, to fill the (small) pots properly.
- The response time is mainly the same, but by using standard varieties for it, it can be slowed down (caused by extra growth-retarders-treatments). The total croptime is normally shorter, because of the shorter LD period.
- Pinching can be done, but is not recommended.
- Growth-retarding is very important. Especially when using standard varieties it is essential and a lot of treatments are necessary. (Therefore we recommend using specific mini-varieties, Growth-group 1-3).
- Fertilization and Irrigation is basically the same, however could be adjusted because of the smaller pot.
- For all other cultural requirement the same approach.

5.5 Big Pot/Plant Bowl Culture

All the cultural recommendations given for the standard culture also apply for the Big Pot and Plant Bowl culture.

Typically for these cultures is the use of more than one cutting in a pot/bowl. It can be an interesting part of the Kalanchoe culture for the grower, especially when he uses his creativity to make special creations (pyramid, cascade shaped etc).

The most important requirement for these cultures is using varieties that are very uniform. Or in case of mixing varieties, use varieties that can be grown together (the same response time and other cultural demands).

§ 6 CULTURE (SPECIFIC CULTURES)

6.1 Kalanchoe in warm (tropical) countries

This culture description is based on the climate in Northern and Western Europe. However, more and more Kalanchoes are grown in countries where the climate is more tropical. Adjustments have to be made to the culture. In warmer areas the following aspects have to be considered.

- Adjust the varieties. The growth-group we recommend for our varieties must be adjusted. Varieties in growth-group 3 must be read as growth-group 4 in these areas (countries).
- By experience we know that mutations are easier taking place, so that's why it's important for the choice of the variety and also it creates the necessity of using every year new selections for motherstock.
- The rooting is faster, so the Long Days period is shorter and the Short Days-period can start earlier.
- The medium must have extra water-holding elements, but don't forget the other recommendations. It is however difficult to get the same type of medium as used in Europe. That can in some cases lead to a totally different approach of the requirements. For that reason we recommend to contact specialists.
- The total croptime over the year is more the same, no more than 2 weeks in general (remember in Northern Europe it can differ up to 5 weeks).
- To pinch or not to pinch is basically not different, but with more light the necessity to pinch is less, but in case of pinching the right time is important.
- Because of the higher light-levels there will be more growth, so that means also more use of growth-retardants.
- Fertilization is also in this situation a very difficult subject to give recommendations about. In general the experience is that the level can be brought up (total EC) a little bit, but how far depends on a lot of circumstances.

A higher EC can influence the stretching (more compact), the colour (more intense) and the keeping quality (longer).

But especially in real hot weather (longer periods more than 86°F/30°C) it means that the total EC might not be too high (the plant-activity is low, so what can it do with the fertilizers) and also the individual chemicals can react in a different way.

For instance nitrogen can create a barrier for other elements, which means overstretching of the plant, which can hardly be stopped by retardants.

- Higher demands on irrigation (more) and water quality.
- Adjustments to the Long Days and Short Days periods.

For countries south of the Equator, take the opposite advice on the seasons (winter=summer).

- Temperature and humidity control are of the utmost importance and require perhaps the highest consideration. A high light level can be perfect as growing conditions, but might be totally useless when that also means extremely high temperatures and a low humidity (see chapter 2.4).

Ventilation and other cooling systems can be essential.

Temperatures at night can be low, 56-60°F (14-15°C). Heating is than necessary, especially when the day-temperature is over 76°F (25°C).

- Plant health is also more important, because diseases can spread (reproduce) more easily in a warmer climate.

6.2 Kalanchoe as a Garden/Border Plant

Besides its use as a house (indoor) plant, the Kalanchoe also proved to be a perfect garden/border plant. The fantastic bright colours, the keeping quality and the low water-requirement make it a joy in the garden.

In the garden the Kalanchoe has a average keeping quality of 15 weeks. Depending on the weather (and variety) it flowers three times, divided by a short resting period.

Very interesting is the fact that in the 2nd and 3d flowering period the flowers are nearly twice as big.

Because the culture of Kalanchoe starts indoors, it is only possible to plant them outside when the temperature is at least 68°F (17°C). In fact, the only real trouble for outdoor use is the cold temperature (below 64°F/16°C.) The best time to plant them outside is one week after the first flowers opened.

Outdoors the Kalanchoe will change its appearance. The leaves are getting darker (brownish red) and also the flowers can change in colour, mostly more intense.

It needs to be said that not all varieties can be planted outdoors. We can divide the varieties by colour.

- Purple - by far the best to use, changing to dark purple.
- Red - the second best, changing to dark red. Most varieties suffer from flower damage just after planting.
- Pink - changing to dark pink or reddish pink.
- Orange - changing to dark orange or orange-red. Sometimes flower damage can appear just after planting.
- Yellow - not recommended for garden-use, because the colour yellow is changing to light-orange.
- White - not recommended either, because the colour changes to light pink.

§ 7 CULTURAL RECORDS

Recording of cultural information is very important, e.g. for tracing mistakes and problems.

Record information for every culture of:

- date of sticking
- pinching
- beginning of SD
- dates of treatments with retardants
- dates of treatments with chemicals
- supplies of water
- supplies of nutrient

With the figures of analysis, you can compare different crops and learn to improve future crops.

§ 8 OTHER INFORMATION

For more detailed information and cultural assistance, please contact the FGB cultural specialists.

If there is any information that can improve the quality of this cultural guide, please contact us.

Fides Potplants

Postal address: P.O. Box 26, 2678 ZG De Lier, Holland

Office: Coldenhovelaan 6, Maasland, Holland

Phone: +31 (0)174-530005

Fax: +31 (0)174-530055

E-mail: Info@fidesstraathof.nl

FGB (Fides GoldStock Breeding)

Postal address: P.O. Box 26, 2678 ZG De Lier, Holland

Phone: +31 (0)174-530000

Fax: +31 (0)174-530053

E-mail: Info@fgb.nl

Internet : www.fgb.nl