

## ALSTROEMERIA CULTIVATION GUIDE

The origin of Alstroemeria can be found in South America, especially countries as Chili, Peru and Brasil. In the middle of the sixties Alstroemeria was for the first time grown in western Europe. Alstroemeria has established a strong growth. In 1977 there were 10 ha. of cut flower Alstroemeria grown in Holland. Ten years later in 1987 this area had already increased to 71 ha. By 1990 the declared area had grown to 84 ha. and in 1997 it stands at an estimated 117 ha.

In 1975 the turnover of Alstroemeria on the Dutch flower auctions had already reached around DFL 3 million guilders, and by 1996 this figure had increased to DFL 82 million guilders (inclusive of DFL 13,5 million guilders imported produce).

Alstroemeria therefore belongs to one of the quickest growing small crops, although within the last two to three years the area in Holland has become stable. With increased use of ground cooling and the positive effect this has on flower yield, production per m<sup>2</sup> has continually increased. The increased production of flower yield is also a result of newer and more productive varieties.

The year round supply of Alstroemeria has increasingly improved with the influence of ground cooling. Also with new breeding techniques and optimal growing conditions the winter production of Alstroemeria has considerably increased.

Labour costs with the aid of specialization, critical selection, mechanisation and optimal growing procedures, can be kept to a minimum.

### **Glasshouse design.**

Alstroemeria is a plant which can be sensitive to light and temperature. It is therefore very important to pay attention to the suitability of your glasshouse facilities. Good new glass is preferred to offer optimal light conditions during the darker periods of autumn, winter and early spring. Optimal ventilation along with chalk sprayed glass or possibly an installed screen will help to control the air and ground temperature during the months which give highest heat radiation.

In the open field Alstroemeria's can also be grown, although the weather conditions do influence the growing of the crop directly. Making use of plastic tunnels or greenhouses is very useful if there are possibilities for enough ventilation. Covered growing has to be advised just to be less dependent of weather circumstances. It has a positive impact on quality of the stems (length), leaves (hardness, longevity), production (per m<sup>2</sup> or per plant) and vase life (better uptake of water and minerals).

A working area with sufficient space for the use of a bunching or grading machine, along with leaf stripper, binding machine and work tables will offer a quick handling of the flowers. A large enough cold store, where in peak periods the already cut flowers can be stored is also preferable. The layout of the packing area should be designed so that the walking distances between each point are as short as possible.

For irrigation, a spray line is placed at the bottom and in the middle of each Alstroemeria bed, where Alstroemeria is grown on substrate systems with rolling tables a drip line or seep hose is used. The support of the crop is rather dependant on the variety, 3 to 5 wire nets per bed are needed. The square width of the wire net is 17 x 20 cm or 18 x 20 cm. In addition

CO<sup>2</sup> can be distributed by using a pipe positioned within the bed or via a central system. Heating for the crop can be conducted by using pipes above and below the bed. Day lengthening is preferable with specific varieties of the Preesman assortment.

### **Soil.**

For the best wished crop results the most important factors are the structure and the water retention capacity of the soil.

Alstroemeria can develop a large leaf mass and therefore dependence on water during the spring and summer months is high. Within this time an Alstroemeria crop can evaporate three to six litres of water per m<sup>2</sup> per day. From experimental work and practical trials it can be seen that flower yield is decreased if insufficient water is given. Also the soil requires to be free draining with a consistent water level throughout the year. In addition the soil should contain sufficient water retaining material but must not remain sodden. Consistently wet soil with a high water table must be under drained. A normal soil with reasonable drainage would benefit an Alstroemeria crop further if it were under drained.

The soil should have a low salt concentration, be free from soil born diseases and insect parasites. Continually a new rhizome is made and roots are formed. It is therefore understandable that a good soil structure with an optimal air/water ratio is of utmost importance to the success of the crop.

### **Soil type.**

Alstroemeria can be grown on nearly all soil types. In general a soil with a pH of 5.5 to 7 is best suited for growing Alstroemeria. It is therefore advisable to first take soil samples, from which pH organic matter, content of silt and nutrient levels can be established. Ensure that this is completed in time, so that any arising problems can be rectified. Plant Alstroemeria in disinfected soil to avoid soil born diseases and to create good weed control.

With *sand soils* the water retention is usually low. The incorporation of organic material into the topsoil helps to improve this. Also with sand it can be seen that nutrients are quickly drenched from the soil. Frequent distribution of fertilizer and irrigation will help to compensate this.

In *peat soils* Alstroemeria shows a much quicker and luxuriant growth than with clay soil. The suitable pH and constant humidity of peat provide excellent conditions for Alstroemeria. Having a heavy dependence on a consistent water supply, Alstroemeria is particularly suited to growing in peat and good results can be expected when using this medium.

*Silt soils* with an open structure are also suitable for growing Alstroemeria. Naturally, clogged and compacted layers within the soil should be cleared. The tendency for silt to become clogged or compacted can be avoided by incorporating organic material into the soil. A ratio of 2 to 5 m<sup>3</sup> of organic material per 100 m<sup>2</sup> can be incorporated.

The ratio is dependent upon the organic content and structure of the material used. Organic material such as bark, manure, peat dust as well as lava stone, pumice stone or coarse sand can all be used to improve the soil structure. With most silt soils it is preferable to use a mixture of sold manure and composted bark. Due to the salt sensitivity of a young Alstroemeria crop the use of fresh manure is not advised.

*Clay soils* which are rich in chalk can be seen to give good results when peat is incorporated. Incorporating old manure is not advised as this makes the soil too rich.

However as with silt soils incorporating materials such as composted bark can give good results. The open structure of bark as well as lava stone, pumice stone and coarse sand can improve the air/water ratio. It should be noted that the use of peat and bark can slightly lower the soil pH level. Although in practice it is repeatedly seen that the application of acidic fertilizers has little or no effect upon pH

### **Fertilization.**

By analysing a taken soil sample, nutrient levels that are low can be adjusted, so that before planting complete nutrient levels are brought into line.

Optimal nutrient levels for Alstroemeria for the start of, and during the growing period, are as follows (mmol/litre in an 1:2 extract):-

	<b>Optimal Level</b>	<b>Lower and Upper Limits</b>
PH	5.5	5.0 - 7.0
EC	1.0	1.0 - 1.4
NH <sub>4</sub> <sup>+</sup>	<0,5	<0.5
K <sup>+</sup>	1.5	1.0 - 2.5
Na <sup>+</sup>	<2.0	<2.0
Ca <sup>++</sup>	2.0	1.0 - 4.0
Mg <sup>++</sup>	1.2	0.7 - 2.0
NO <sub>3</sub> <sup>-</sup>	4.0	2.0 - 8.0
CL <sup>-</sup>	<2.0	<2.0
SO <sub>4</sub> <sup>--</sup>	1.5	0.7 - 4.0
H <sub>2</sub> PO <sub>4</sub> <sup>--</sup>	0.15	0.1 - 0.2

(Source 'adviesbasis' Alstroemeria 1993)

These levels are based on Dutch circumstances. We advise not to use these levels very literally, the levels of each specific element that needs to be applied are dependent on circumstances, soil type, variety etc. changes on the above written levels can be necessary. Therefore it is sensible, before starting with the culture of Alstroemeria, always contacting Preesman B.V. to see which is the right way of fertilizing. Every climate and soil has its own fertilizing. Regular fertilizer application, where nutrient levels have dropped will become a necessity. It is therefore recommended that regular soil samples are taken so that nutrient levels, and levels of trace elements can be followed. Additional fertilizer application of singular nutrients via the irrigation pipes can also be practised. In Holland this is conducted by using A & B containers each holding a separate nutrient. This nutrient is then singularly applied through the irrigation pipes. This system of additional fertilizing works very effectively.

A poor absorption of trace elements by the plant is usually caused by a too high pH level or a poor functioning root system.

*Iron deficiency* represents itself by a yellowing of the youngest foliage. Application of an iron chelate Fe EDDMA and the use of acidic fertilizers can help to avoid iron deficiency.

*Manganese deficiency* causes leaf yellowing between the nerves, mainly upon the youngest foliage.

A foliar spray of manganese sulphate applied during clouded - overcast conditions can rectify this problem.

*Magnesium deficiency* can be seen by a fading of the foliage colour, usually around the middle and lower parts of the plant. A spray with bitter salt (magnesium sulphate) will darken the foliage and give the crop a better appearance.

The additional use of granulated fertilizers can have a positive influence on the quality of the crop and growing pattern of the Alstroemeria (more regular with less blind stems and shorter length). Of course this is dependent on variety, season, soil type etc. The following fertilizers can be used, e.g. Patent potassium (K<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>), Kieseriet (MgSO<sub>4</sub>) or Prills (12-0-43-4).

### **Water quality.**

Alstroemeria is sensitive to salt. It is therefore of great importance that a good quality water is used with the crop. The best used water is rain water. A good water container with a capacity of 200 - 300 m<sup>3</sup> per 100 m<sup>2</sup> of glasshouse roof area is recommended. Obviously the water quality from one area to another can change, although it can be said that the average quality is not optimal. It is advised that water with a higher EC than 1.5 ms/cm and a higher Na and CL content than 3.0 mmol/l should not be used. Caught 'surface water' already has an EC of approximately 1.0 ms/cm. It can therefore be seen that this leaves little room for increase, which will occur with the distribution of fertilizer. In dry periods particularly the EC level and the level of chlorine within 'surface water' can increase to above the desired concentrations. The use of mains water can lead to a locking of iron in the irrigation system, although this does not have a direct effect on the crop. The content in the irrigation water should be no higher than 10 micro mol per litre.

### **Variety choice.**

The choice of Alstroemeria variety is very important. Its influence upon, and relation to labour and crop requirements can have a dramatic effect on the crop. As well as the aurantiaca, butterfly, orchid, Carmen and similar types there are increasingly more hybrids with more winter flowering.

The choice of variety is determined by many factors. A good variety should meet the following requirements: large flower buds that show complete colour; good bud formation; large flowers; strong colours; strong in handling; a robust and heavy flower stem; a good keeping quality. A limited flower length, gradual ripening and a high flower yield are positive characteristics that will also help to increase profitability.

Naturally the cultivation requirements of a specific variety should be considered when making your choice. Some varieties require a more water, less light, lower air temperature or soil temperature than others. It is therefore possible to select varieties whereby it is necessary to use soil cooling, it is necessary to use artificial light (photoperiodic or assimilation) or a grower may give the preference to a variety that does not specifically require soil cooling or artificial light or other equipment. This is a personal choice that each grower must make for himself. Also the labour requirement, production and quality of a variety has to be considered.

With the application of 'supplementary day lengthening lighting' the flowering time of some varieties can be increased.

Try to select varieties which can be combined so that they will not all reach their peak yields at the same time.

### **Planting.**

The time of planting is much dependent upon the type of variety chosen, the climate area, circumstances, experience of the grower, etc. For nearly all varieties a reproductive period of 3 - 4 months (from the time of flower production) is needed to secure a sufficient plant formation and sprout forming.

Alstroemeria is more and more planted year round. Planting in the autumn gives a flowering time of 14 till 16 weeks later, beginning spring, end of the winter.

To avoid a too vigorous reproductive growth when planting in the autumn it is necessary to thin the plants by pulling blind stems regularly. When planting in spring or summer it is necessary to built up the crop by pinching the first ten till fifteen stems on a plant. By doing this the grower can assure himself of a crop of Alstroemeria which has enough length and "body". Later on during winter these pinched stems can be pulled out. Planting in spring or summer gives flowering after 10 till 12 weeks.

When planting takes place in the spring it is important to monitor the nutrient levels regularly. A higher nutrient level with sufficient water is usually desired to compensate for the shorter reproductive growth period and to realise adequate plant volume before production is started.

### **Planting density.**

Alstroemeria beds are usually 1.0 m to 1.20 m in width, with footpads of 50 cm to 60 cm. The Alstroemeria bed is planted in two rows parallel to each other. Dependent upon variety the distance between each plant varies from 30 - 60 cm. It is advisable to keep to a planting density of 3 - 4 plants per gross m<sup>2</sup>.

### **Glasshouse and soil temperature.**

Depending upon the planting period, during the early spring, a slightly higher glasshouse temperature of 16-18 °C can be maintained. When the plant is established (3 to 6 weeks after planting) this temperature can be gradually reduced to a more suitable growing temperature of 12 – 15°C, dependent on circumstances.

During the first 6 week after planting, a soil temperature of 13 - 16°C is desired to ensure an easy root establishment in the soil. With later plantings during the spring and summer period, it must be noted that during this time the soil temperature can easily rise above 17 - 18°C.

The first 10 weeks these temperatures favours the development of the plants. Later on this can lead to a too vegetative plant growth. In addition to this less sprout is formed during the long day period. Therefore it is necessary to built up enough crop during the first weeks after planting by giving enough temperature, water and fertilizers.

An optimal soil temperature during summer conditions is 13 – 18°C. Soil cooling with pipes at rhizome level can help to achieve this temperature. The necessity of soil cooling is dependent upon the used variety, climate area, type of greenhouse, experience of the grower etc. By applying day lengthening light, the use of soil cooling is not necessary. A good managing of the flowering is in that case possible.

### **Crop maintenance.**

Other than flower cropping, crop maintenance with Alstroemeria is mainly tied to 'crop thinning' and 'crop support work'. The 'pinching' and 'thinning' of thin blind stems brings air and light into the crop. At the same time this work is beneficial to the sprout formation. Naturally the condition of the crop should be carefully and continually monitored. There are of course varieties that need very little or no 'crop thinning'. With young Alstroemeria crops the thin sprouts are pinched. In spring particularly this action is preferred rather than severing the thin and loose plants completely. During the summer these 'pinched' sprouts help the crop by providing an insulated cooling effect. This protects the soil and plant temperature from quickly increasing and keeps the stem quality long and heavy enough. Depending upon the variety, older crops need more or less thinning, in the autumn and winter period. To achieve a consistent crop formation and a steadily growing crop, it is necessary to practice crop 'thinning'.

The continual replacement of stems that grow out of the support nets and into the footpad prevents stems being either broken or damaged. To help reduce this work it is sensible to keep the bottom net in a very low position. This will train the stems to grow in a more upright manner, and prevent them growing outside the bed width. Also when planting it is advisable to plant the two rows more to the middle of the bed.

### **Light.**

The flower stem quality of Alstroemeria is for the main part determined by light, and it is therefore that light is a particularly important growing factor with Alstroemeria.

The quantity of light also determines, for an important part, the speed of photosynthesis, and thus the speed of growth. In the autumn, winter and spring periods as much light should be applied to the crop as possible.

In the period of spring and summer it is often necessary to reduce the level of light. This can be achieved by spraying the outside of the glass white (chalk based substances) or if possible by using a thermal screen. This practice also helps to prevent the soil temperature from quickly increasing. Furthermore, it limits the rhizome temperature, so that the flower sprout formation becomes easier, and production is raised.

### **Day length.**

With a day length of more than 14 hours an Alstroemeria forms less sprouts: the further the day length is increased the more the sprout formation is decreased. After the long day conditions have passed this stunting of the growth can go on for some time. During the long day conditions the plant degenerates, it forms very little foliage and the sprout growth is retarded. Also during long day conditions the amount of foliage carried by the plant is reduced. The flowers are induced much quicker, but the yield of flower stems is always less. For this reason also, the size and quality of the eventually cropped stems is often less good.

Under short day conditions the rhizome grows much stronger than when under long day conditions. This is why under short day conditions many flower sprouts are formed. Also under short day conditions the amount of foliage carried by the plant is considerably

increased. Under short day conditions much more foliage can be seen to split and branch out before the flowers become visible.

Also it is evident that the growing pattern of an Alstroemeria-crop should be as regular as possible. In that case, soil temperature do not influence the flowering that much.

In the late summer and autumn period it is possible to use the practice of day lengthening, to generate the crop. Day lengthening can be applied to an Alstroemeria crop with the use of tungsten lights (10 - 15 w/m<sup>2</sup>) giving a day length of 12 to 16 hours. A lighting period a few weeks is sufficient to establish bud induction in the flower sprout, depending on variety etc. Sometimes it is possible to give light for a longer period. The lighting should be interrupted when less than 5 young flower sprouts per plant are visible. Also by the end of the winter ,day lengthening can accelerate the flush production in spring.

Day lengthening can also be practised using assimilation lighting, up to a maximum day length of 14 hours. However, it is not imperative that assimilation lights are used instead of tungsten lights, when practising day lengthening lighting. The choice is very dependent on whether growing Alstroemeria under assimilation lights remains economical.

Although it must be said that assimilation lighting adds a recognised increase of quality to the eventually cropped stems.

### **Temperature.**

The influence of temperature upon an Alstroemeria crop is very important and soil temperature in particular is of high importance. The flower induction occurs at a temperature of 14 – 20°C, thereafter the maturation of the plant is strengthened at higher temperatures (above 20°C). Soil temperatures higher than 20°C must be avoided, as these temperatures inhibit and decrease the flower induction. With lower summer temperatures it is possible to achieve a greater flower production in the autumn period. A soil temperature which is too high will inhibit the establishment of flower buds, and from this the possibility of finding loose and weaker stems is increased. With the aid of soil cooling the soil temperature can be kept between 14 and 17°C. This is good range of temperature for many varieties to stimulate flower bud establishment.

From research it has been confirmed that, between the different species, there are certain differences in sensitivity to temperature.

### **Humidity.**

Alstroemeria is most comfortably suited to a humidity of between 65% and 85%. A humidity that remains too high can create a weak crop, that is much more susceptible to disease. A thrust of temperature with active climate control will stimulate a humid environment. The humidity can be released by the use of air vents. A humidity that is too low can cause leaf scorch, this usually occurs during periods of rapid transition, from dull overcast weather to bright sunny weather. During the spring period certain varieties are very susceptible to leaf scorch. As policy it is essential to ventilate.

### **CO<sup>2</sup>.**

From research it has been established that CO<sup>2</sup> dosing with Alstroemeria crops, particularly in the autumn and winter months, produces a recognised increase of quality to the flower stem. By CO<sup>2</sup> dosing the flower quality is better, the time of flowering is early and the production of flowers is increased. During periods when the crop may need to receive more

air it is advisable to distribute CO<sup>2</sup> at the ambient air content.

### **Post harvesting.**

The labour needs with Alstroemeria can vary considerably, depending much upon the following factors: variety choice, planting time, the use or not of ground cooling, a first year or multiple year crop and the picking or cutting of the flowers.

Globally, 800 to 1.100 man hours per 1.000 m<sup>2</sup> is required when growing Alstroemeria (source DLV Naaldwijk /The Netherlands). The labour needs between the different varieties can be extremely variable. There are varieties that require twice the work to other varieties.

The varieties that are sufficiently supported with three nets require less labour, while varieties demanding five or more nets for support are more labour intensive. Dependent upon the chosen variety selection, less than 20% to 30% of all work time is dedicated to activities other than harvesting and bunching. Sancerre, Capri and Davos are among those varieties that are proven to take the least amount of minutes work for the harvesting and bunching of 100 stems. Much of this is owed to their favourable short stem length which offer a more accessible crop. The more new varieties such as Pierrot®, Grand Nice<sup>7</sup>, Charmes<sup>7</sup>, Atol<sup>7</sup>, Circus<sup>7</sup> and Harlekijn<sup>7</sup> do have the same low labour requirement. Alongside production levels and flower quality, reduced labour costs for a variety play a decisive role to the crop economy. Dependent upon the variety, the soil type and the crop stage the flowers are either pulled out or cut. For practical purposes it is usually preferable to pull out the flowers. Except at the start of the crop when the plant rhizomes can be pulled loose, during which times it is recommended to cut the flowers. On some soil types, after a peak cropping period for instance, temporary cutting can take place so that the rhizome is given some rest.

### **Grading.**

The flower stems are graded into three classes. Class One flowers are 80 cm long with rigid stems and show three or more flower stems per stalk. Class One flowers should also be free of any chemical residue and animal or plant parasites. Second Class or Class B flowers should have a minimal length of 60 - 70 cm, with three or more flower stems per stalk, together with one and two flowered stems. The strength and rigid ness of Second Class stems is lightly less than that of Class One. Obviously different auctions/markets have varying classifications. Seek further information from the auction/market where the flowers are to be sold.

### **Flower treatment and keeping quality.**

It is best to crop the flowers at a sufficiently ripe stage, this is beneficial to the keeping quality. A sufficiently ripe stage is when certain flowers are showing full colour but are not quite open. In Holland the flowers are delivered to the auction in containers. The flowers are placed in water treated with a growth substance (GA<sub>3</sub>). The treatment is applied to combat eventual leaf yellowing. Sometimes a treatment of silver-thiosulphate (STS) is applied to protect the flowers against ethylene levels. Flowers treated with STS must be transferred to clean water before they are transported to the auction.

Brands of this treating agent are: Ciro-Fleur, Chrysal SVB, Florisant 110, Alstroflor and the combination Chrysal SVB/AVB. Only Chrysal AVB contains silver.

Flowers placed in water treated with one of these agents, can be placed in cold storage at a temperature of around 5°C for at least four hours. However, the most beneficial practice for keeping quality/vase life is to ensure that the flowers are only cropped when sufficiently ripe.

### **Crop protection.**

In the "Crop protection guide for cut flowers", available from the "Plantenziekten-kundige Dienst" in Wageningen (phone number: + 31 317 49 69 11) much information can be found regarding crop protection and crop protection agents. Also the guides in your own country can provide information about the allowed chemicals. Naturally it is necessary to carefully study the details labelled upon the packaging of any chemical/control agent. Also, only use them in accordance with the written instructions given. Only pesticides which are allowed in The Netherlands are described in this cultivation guide.

*Soil disinfections* is best conducted after the incorporation of organic material in the ground and before planting. Disinfections by steam controls ground fungus, nematodes and insects. At the same time it also keeps the soil free of weeds for a longer period of time.

*Nematodes* *Pratylenchus penetrans* and *P. bolivianus* can cause a reduction in growth, from which a clear loss of production and quality can be seen.

A presence of nematodes causes the plant to first lose its vigour and growth, fade in colour and then die off. A symptom of nematode infestation are small light brown length way strains, that become visible upon the underground part of the flower stem. Nematodes usually represent themselves in a group like fashion. This can be seen by the inconsistency of an infested crop. The best remedy to this problem is to ensure that the soil is steamed, and to use healthy planting material.

The following control agents can be applied: Temik 10G, Oxamyl (Vydate-I) and Fenominofos (Nemacure Granulate). The use of Temik and Vydate must be repeated to ensure an effective control. Make sure that sufficient water is given to drench the chemicals into the soil. Apply the control agent during an active period of plant growth.

*Leaf Aphid* (Aphididae) causes misforming to the leaf and to the sprout. The aphids are usually to be found on young leaves and flowers. As soon as the temperature is increased, the aphids become active. The aphid pierces and sucks the foliage causing the growth to become retarded. Hereafter the plant becomes misformed and the crop fades in colour and wilts. A quick and effective control can be achieved by spraying with: pirimicarb (Pirimor), propoxur (Undeen), heptenophos (Hostaquick), methomyl (Lannate), oxamyl (Vydate-L) or methiocarb (Mesurol-L).

At times it may only be necessary to treat a certain area of the crop. This can be conducted by spraying with: pirimicarb (Pirimor), propoxur (Undeen), sulfotep (Bladafum II), lindane (Lirogram) or a synthetic pyrethroid insecticide such as permethrin (Ambush), deltamethrin (Decis) or esfenvalerate (Sumicidin Super). Complete crop spraying or spraying specific crop areas can give good effective results.

*Red Spider Mite* (Tetranychus) are small spider like aphids that are usually found on the

underside of the leaf. A red spider mite positions itself in the plant cells and sucks until these cells are empty. From this action small white dots can be seen on the underside of the foliage. With high levels of infestation the plant foliage turns yellow, wilts and then dies off. The time that it takes a red spider mite egg to develop is at 15 and 30°C, 40 and 7 days respectively.

As control it is necessary to apply a minimum of two sprays with an interval of 7 to 10 days. Spraying certain areas of the crop, where the source of infestation seems to have begun, is not advised. Usually by this time the red spider mite is active throughout the crop. Spraying with the following is advised: dinochlor (Pentac), hexythiazoc (Nissorun), fenbutatinoxide (Torque plus), bifenthrin (Talstar), abamectine (Vertimec), fenpropathrin (Kilumal), chlofentazine (Apollo), Glucycloxuron (Andalin) and pyridaben (Aseptacarex).

*Thrips* (Thysanoptera) are small (2 mm) slim moving insects that cause damage in particular to young foliage. Upon the foliage silver coloured strains appear and the shoot tops are crumpled. Flowers are misformed and their colours become streaked. At the same time the flowers fail to mature and open, and the petal tops become brown. Thrips becomes particularly more active at higher temperatures. For example the time taken for one egg to develop to another is at 15 and 25 – 30°C, 2 months and 14 days respectively. Tobacco Thrips and in particular Californian trips should be consistently and thoroughly controlled. With an attack of Thrips spray around every five days with: methomyl (Lannate), oxamyl (Vydate-L), acefate (Orthene), mevinphos (Phosdrin), methiocarb (MesuroL-L) or carbofuran (Curater-L). To treat a specific area "organic phosphorus compounds" (e.g. Phosdrin) can be used. At times these compounds are known to may cause leaf scorch.

Applications of these compounds should therefore be very carefully conducted, all use should be in strict accordance to the written instructions. When using organic phosphorus compounds, the glasshouse temperature should be a minimum of 12°C. With a heavy infestation spray the crop and treat individual areas of the crop once weekly.

*White fly* (Aleyrodidae) also causes damage by sucking at the plant foliage, and can also spread virus from one plant to another. The adult white fly is a snow white winged insect of 1.5 mm in size and usually appears on the underside of the leaf. The time taken for one egg to develop to another is at 15 and 25°C 8 and 3 weeks respectively.

To combat white fly use buprofezin (Applaud), teflubenzuron (Nomolt), Oxamyl (Vydate-L), methomyl (Lannate) or pyridaben (Aseptacarex). It is recommended to combine complete crop sprays with the spraying of individually affected areas.

*Leaf Miners* (Liriomyza). The most commonly found leaf miners are the nerve and Florida leaf miners. Adult leaf miners leave a trail of white dots on the young foliage while the larva makes irregular shape holes (mines), usually found on the underside of the foliage. The dark flies are 2 mm in size and have a yellow spot on their back. During the winter months the life span from egg to egg is up to 8 weeks and more, although during the summer this period is reduced to less than 3 weeks. To control an attack of leaf miner, spraying should be repeated three times, each time after 5 days, with abamectin (Vertimec), methomyl (Lannate), cyromazine (Trigard) or oxamyl (Vydate-L). Also give a weekly application of organic phosphorus compounds (Phosdrin) or a synthetic pyrethroid such as permethrin (Ambush), deltamethrin (Decis) or esfenvalerate (Sumicidin Super) to the individual areas of the crop that may be worse affected. Remember that use of organic phosphorus compounds can cause leaf scorch.

*Caterpillars* must be timely controlled to prevent a major attack. Caterpillars are the larva of

butterflies, which are particularly active in the summer and autumn periods. It is during this time that they enter the glasshouse and lay their eggs on the underside of the leaf. Within days the eggs are hatched and after 4 to 8 weeks the caterpillar begins to pupate the cocoon. By eating the plant foliage caterpillars can cause enormous damage to an Alstroemeria crop.

To control caterpillars use trichlorfon (Dipterex), methomyl (Lannate), teflubenzuron (Nomolt), diflubenzuron (Dimilin), the prepared bacteria *Bacillus thuringiensis* (Bactospeine) or a synthetic pyrethroid such as permethrin (Ambush), deltamethrin (Decis) or esfenvalerate (Sumicidin Super).

*Slugs and Snails* can at times become quite widespread in an Alstroemeria crop. The presence of both becomes greater in humid conditions, and both are usually found to feed on young foliage, during the dark.

Snails and slugs can lay many eggs within ground hollows. After approximately two months these eggs will have developed into the new generation and will already be sexually mature. Slug pellets, methylcarb (Mesurol) or methaldehyde (Luxan and Brabants slug pellets) can prevent crop damage. The distribution of slug pellets should be consistently repeated to ensure an effective control.

*Root centipede* is white in colour and has a maximum length of 1 cm. These small animals eat at the roots, and cause the plant growth to become retarded. It is simple to find the presence of root centipedes. By placing a spade of crop soil into a bucket of water the root centipedes will float to the top.

Effective control of root centipede can be achieved by incorporating carbuforan (Curater L) or parathion (Jeboterra granuales) into the soil before planting. It is also possible to spread these control agents between the plants, when the crop is established. Before doing so ensure that the soil is wet and irrigate again after distribution.

*Botrytis* causes the plant to rot, showing fluffs of dusty grey mould. Brown coloured strains appear on the flowers which are also blemished with small lumps. Heating and ventilation is the best remedy, ensure that the crop is kept dry. With regular crop 'thinning' the crop will not only receive more light but also a better circulation of air.

*Pythium* (root rot) usually attacks plants that have temporarily stood in over wet soil. Pythium is also likely to attack an Alstroemeria crop, which is planted in heavy compact soil and remains constantly wet. Pythium gives a glazed appearance to a part of the root which eventually rots away. The inner part of the root remains intact, but the outer glazed area is lost. Pythium can be controlled by using fluralaxyl (Fongarid), propamocarb-hydrochloride (Previcur), fosetyl aluminium (Aliette) or etridazool (AAterra).

With *Rhizoctonia* (foot rot) the stems show rotting just above the soil level. After some time the crop growth gives a retarded appearance. Stems taken from the crop often show brown strains, upon the area of stem that was submerged underground. Avoid large fluctuations in temperature and in periods of warm weather give water, preferably during the evening or night. With an attack of *Rhizoctonia* use a chemical control, but first ensure that the initial source of the *Rhizoctonia* is removed from the crop. Before planting disinfect the soil by steaming and in the event of a *Rhizoctonia* attack spray with tolclofos-methyl (Rhizolex) or iprodione (Rovral).

**Use of chemicals with Alstroemeria.**

Although in this cultivation guide much emphasis is placed on the control of sickness and diseases, it should be mentioned that in this regard Alstroemeria presents very few problems. In comparison to other crops the use of chemicals is little and in this sense Alstroemeria is environmentally friendly.

Within this cultivation guide we have stated a selection of chemicals that may be used against a specific attack or infestation. However, we must stress to you that the chemical instructions for use, are at all times adhered to.

Not all chemicals, as we have stated, can be used in continually changing and different weather conditions. Much thought should be given to this fact before any chemical application. Chemicals that are applied contrary to the written instructions for use can damage the crop, as can use of chemicals under the incorrect conditions, such as too low temperatures or too high humidity.

Although we trust that this cultivation guide will be of considerable help to the success of the crop, we cannot accept any liability for the results of your crop. All the information in this guide is without committing o.s.

Within the crop duration, situations may arise when you wish to seek assistance from our crop specialists. In this instance do not hesitate to contact us:

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