



Aerosols

In Modern Greenhouse Plant Protection



Thermal Fog and Cold Fog Application



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Impressum

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The Alternative: Ultra-fine fog droplets

The task of controlling pests arises with every cultivation period. The traditional method using a sprayer is unpopular because it is labour intensive and often detrimental to health. Up to 80 % of the sprayed liquid runs off the plants and penetrates the ground, affecting the soil fauna with its useful organisms and also the ground water. Frequently, spraying stains deteriorate valuable crops, and high residues of pesticides often affect the quality of vegetables. Last but not least there are conflicting aims when using a sprayer due to the high amount of water required and the aim of controlling fungal diseases.

Low Volume Technique

If you converted one litre of a liquid into droplets of 10 µm diameter and distributed the resulting number of droplets evenly on to an area of 1 ha,

a theoretical coverage of 19,000 droplets/cm² would result.

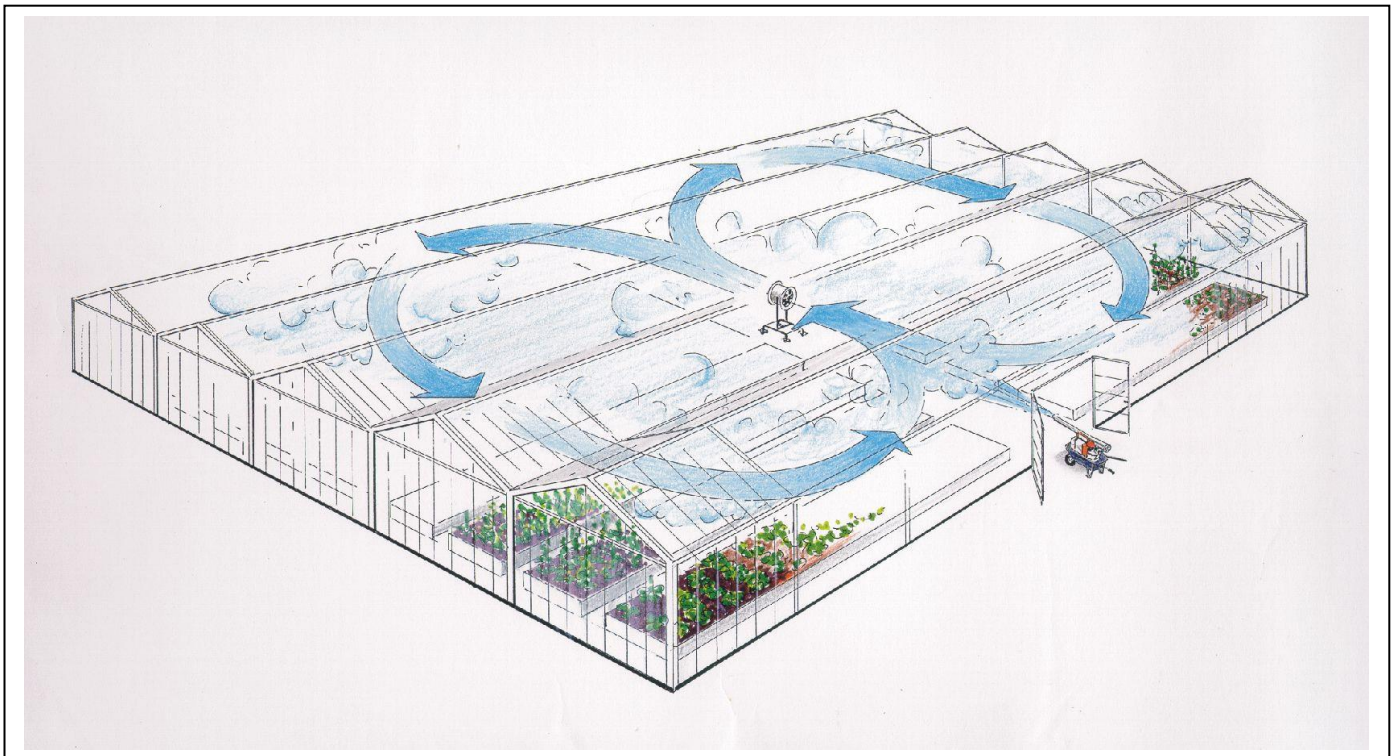
This mathematic consideration explains why the total volume of the solution may be reduced to 1/100 without losing its effectiveness in controlling pests. Using the pulsFOG® equipment, volumes of 1,5 – 3,0 l / 1000 m have proved to be effective.

"Dual Action" of Deposition and Space Fumigation

The aim of **space fumigation** is controlling flying insects such as thrips, whitefly, leaf miner, which are caused to fly up at the same time ("flushing" effect). This is achieved by the action of the gas of certain pesticides on the pests hiding for example on lower leaf surfaces. The insects then become irritated, slip out of their hiding place and receive a lethal dose from air-borne fog droplets.

This effect of space fumigation is produced when stable aerosols smaller than 10 µm are generated.

The aim of **deposition treatment** is to produce a dense residue deposit on the leaf surfaces in order to control eating, sucking, and mining pests and as a preventive action against fungal diseases. Deposition treatment is particularly suitable when using systemic agents, foliage fertilizers and growth retardants. Deposition fogging requires droplet sizes of 10-30 µm. The big advantage of the pulsFOG® fogging technique is that the aerosols with a droplet size of 1-30 µm are merely blown into the air over the crop, settling evenly onto the crop due to their intrinsic properties. If horizontal fans are available the fogger can also be used from a stationary position at the door. The aerosols are then dispersed by air circulation.

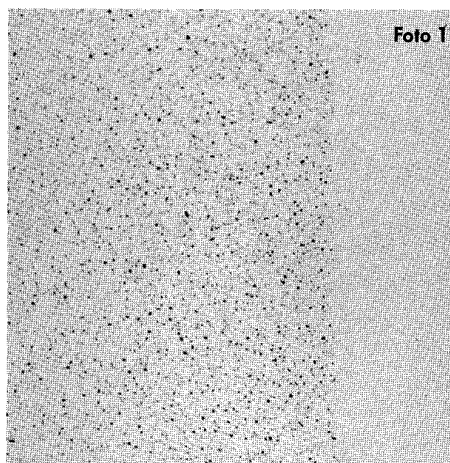


Modern thermal fog application from the outside in using a fan for the fog distribution inside the greenhouse. This application system allows to supervise the operation from outside. Respect the necessary performance of the fan!

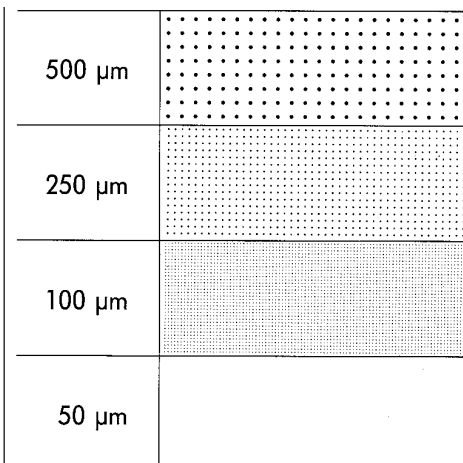
Evaporation

A problem of deposition treatment is the rapid evaporation of the aerosols. Even under a medium relative humidity of 80 % a water droplet of 50 µm diameter has a life span of only 12.5 seconds. When the water portion of a droplet evaporates, its weight and size decreases to such an extent that settling onto the foliage is no longer ensured. This means that it loses its deposition treatment capability.

Chelating (e.g. in nutriFOG®) and other dispersal agents such as "VK-2 Spezial" are able to retard the evaporation of the water long enough to stabilize the droplet size until it reaches the plant.



Fog residue, 10 times enlarged



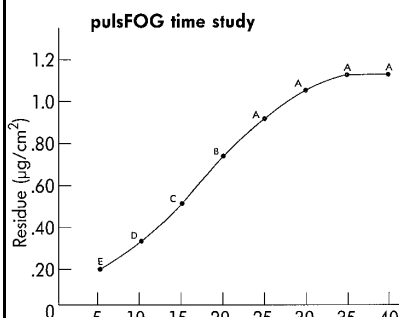
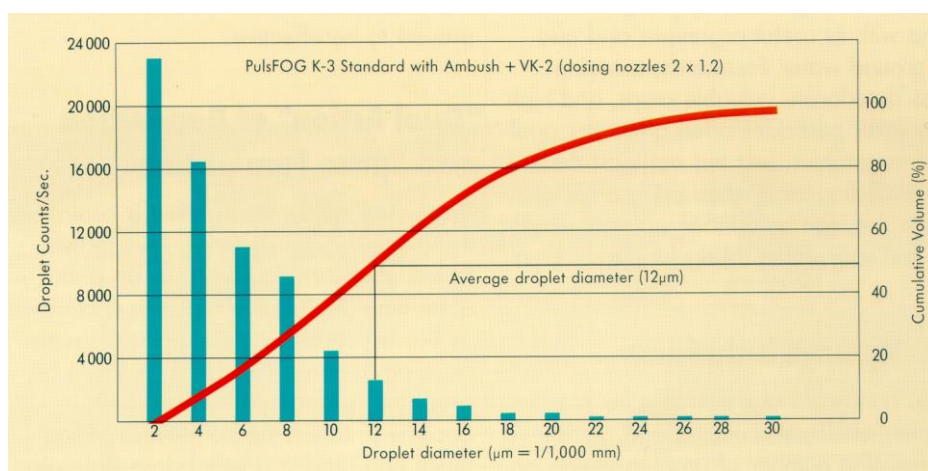
Droplets in natural size

Dispersal Agents

VK-2 special is a neutral, approved fogging dispersal agent designed to retard evaporation. It produces a clearly visible white fog. VK-2 has good plant tolerance properties, however, it should not be applied to Saint Paulia, Gloxinia, Impatiens, Geranium or Begonia while they are in bloom as flower damage can occur. Under these circumstances nutriFOG® can be used as it provides a better plant tolerance. nutriFOG® is a highly effective foliage fertilizer (NPK 10-3-3) which promotes the formation of fog. It is applied primarily in combination with pesticides. nutriFOG® strengthens the resistance and health of the plants, which may be affected by the use of pesticide agents.

Dosage

The pesticide rate per 1,000 m² of greenhouse area is calculated from a spray suspension of 100-300 litres of water. If the chemical label indicates only the spraying concentration (e.g. 0,1%), the initial dosage per 1,000 m² can be determined from the table on the next page. Initially, use only the minimum dosage for crops in bloom in order to acquaint yourself with the method. In the case of unsatisfactory results the dosage may be gradually increased up to the maximum. The application of rates between medium and maximum is restricted to plants with a high tolerance and showing no blooms. High temperature climatic conditions allow only low pesticide rates. The water volume for liquid formulations is 1,5 -2 litres/1,000 m². With wettable powder use the higher water rate of 2-3 liters. Add in the end either 250-500 ml VK-2 special or nutriFOG® dependent to the plant compatibility.



Proof of More Environmental Protection

The pulsFOG® time study shows the result of 5-minute-interval sampling from the fogged greenhouse. The residue already reaches its peak density after 35 minutes. In conjunction with the laser beam test, this proves that far more than 95 % of the fogged product settles within half an hour. The rest of 5 % remains airborne. Therefore the greenhouse must be vented before entering.

Droplet Ø (µm)	During fogging	0	2	10	20	30 minutes
2	3250	6202	1833	1744	1278	374
4	3624	3548	93.1	56	5.6	0.9
6	1136	595	29.5	30	3.2	0.3
8	254	164.2	4.8	2.7	0.3	0.1
10	86	66.6	1.8	-0-	-0-	-0-
12	15	19	0.6	0.3	-0-	-0-
14	7.2	11.8	-0-	-0-	-0-	-0-
16	2.4	1.2	-0-	-0-	-0-	-0-
18	-0-	0.6	-0-	-0-	-0-	-0-
20	-0-	0.6	-0-	-0-	-0-	-0-
22	-0-	-0-	-0-	-0-	-0-	-0-
VMD (µm)	4.5	3.9	2.5	2.4	2.1	2.0

Number of droplets found in the air of a greenhouse by means of a thin laser beam during and up to 30 minutes after fogging, with simultaneous classification of droplet sizes (2-µm-intervals).

Pesticide Distribution and working time

Utilizing the throwing range of an applicator the fog is evenly dispersed while walking backwards through the greenhouse. With a little skill the operator is able to avoid any exposure to the pesticide due to the fact that the fog is propelled well away from the operator by the throwing power of the applicator. A full hectare of greenhouse area can be treated with a rapid fogging system by one person within an hour at a working rate of 3-5 min./1,000 m², using a K-30 thermal fogger or a TracFOG



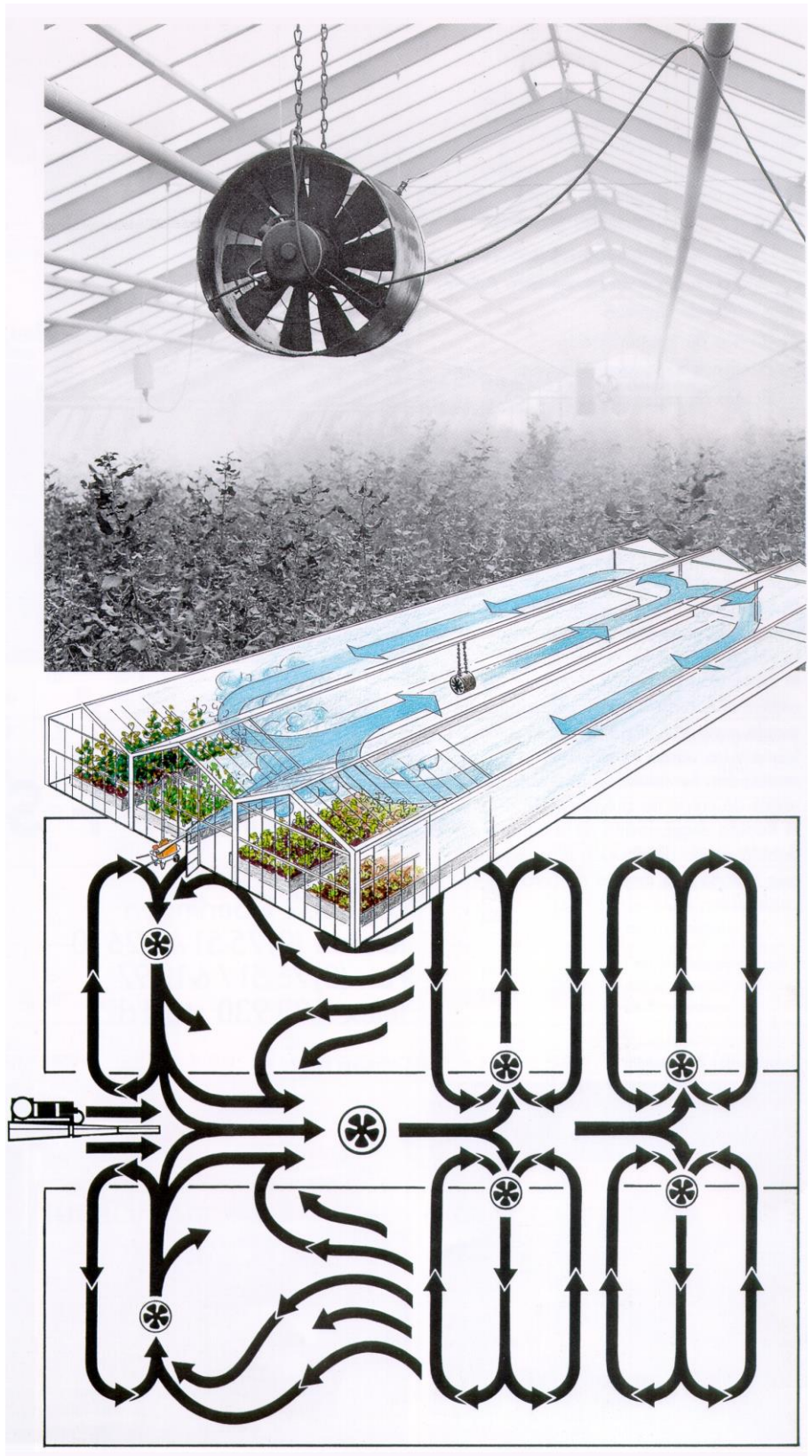
Stationary Fogging

The ability of aerosols (< 20 µm) to stay airborne for longer periods can also be utilized for dispersion by air circulation facilities. The fans required for this purpose should be arranged horizontally and should blow the air directly into the free air space. Fan speed should not exceed 900 r.p.m. in order to prevent the droplet from agglomerating and falling. The size of a fan may be determined according to the following guidelines:

1. Recirculation of the greenhouse air volume within 30 - 60 minutes.
2. A maximum greenhouse area of 1,500 m² per fan, in the case of low greenhouses a maximum area of 1,000 m². The thermal foggers should be fitted with dosing nozzles for finer droplets (such as those used for water fogging).

Stationary fogging facilities are suitable for automatic operation. Larger surface areas can be treated when installing additional fans. It must, however, be mentioned that stationary fogging in general can only be carried out successfully using liquid agents and those with gas and "flushing" effects. Stationary fogging is therefore primarily suitable for room treatment against flying pests. It is not recommended for pesticides formulated as wettable powders.

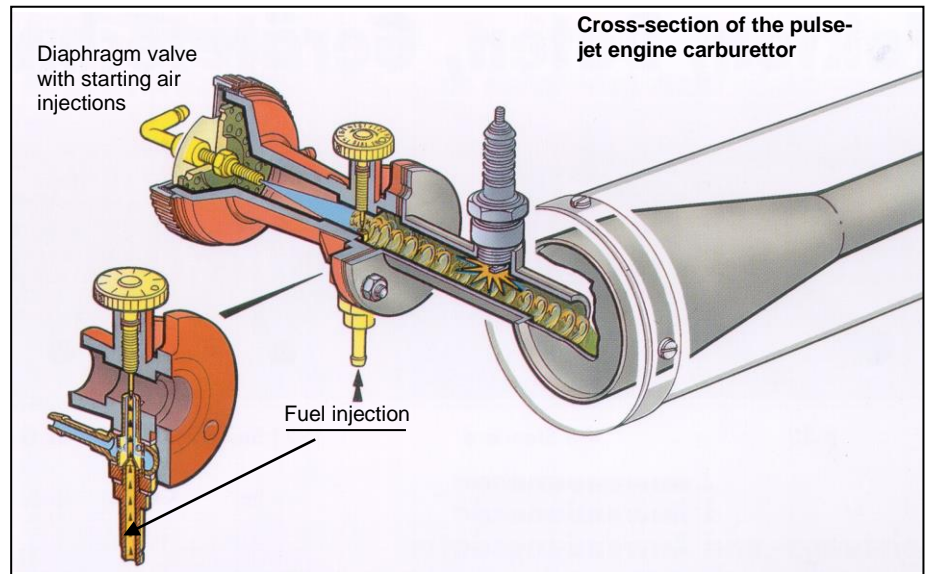
FOG and go...



Thermal Fogger or Cold Fogger ?

The question of the advantages of thermal or cold foggers can be reduced to the following factors: purchasing costs, application time and noise emission. Thermal fogger are relatively inexpensive and work at the high application speed of 3-5 minutes per 1,000 m² greenhouse area which means that it is possible to treat several greenhouses in one evening. The larger types are especially suitable for the application of wettable powder, for fungicide treatment as well as for any other liquid agent. Most of the successful applications with foggers which were reported in particular during the past 40 years in controlling thrips, whitefly, leaf miner, powdery mildew and botrytis were achieved with thermal fogger.

Thermal fogger work according to the pulse-jet principle. These engines do not contain any moving parts (except carburetor diaphragm). The bottle-shaped combustion chamber is empty and opens directly into the exhaust pipe. A resonating diaphragm on the carburetor ensures the controlled pulsating combustion of the fuel in the combustion chamber. The agent of pesticide is injected into the exhaust jet at the end of the exhaust pipe and thermopneumatically atomized, taking advantage of its kinetic and thermal energy. The nozzle system provides a larger drill hole than other fog equipment retarding undesired choking by the pesticide.



Electrical cold fogger (fan fogger) discharge the produced fog very slowly (fogging speed: 1-2000m²/h). They are especially suitable for automatic applications in the night in absence of the operator. The fan builds up an air circulation distributing the aerosols evenly across the indoor surface. WP-formulations increase the risk of blocking the nozzle. An automatic fan fogger operating during the night should not be used with any WP formulations.

The pulsFOG® TracFOG and COLFOGGER overcomes these problems with its new nozzle design using more pneumatic power combined with a bigger drill hole. These power fogger allow fast fogging in presence of the operator (fogging speed: 1-2 ha/h)

Fogging Application Requirements

- Respect the manual of fogging equipment
- Airtight greenhouses with sufficient air space above or between the crops.
- Fog in the evening and when there is less wind outside.
- Avoid the formation of condensing water on the plants, i.e. keep the temperature constant during the night.
- Never fog the crop directly.
- Use stationary fogging only in combination with circulation fans.
- During application within the greenhouse, wear protection suit and gas mask with filter system A₂B₂-P₃.
- Clean the fogging machine after application



Thermal FOG

Cold FOG



Coldfogging with pulsFOG TracFOG or pulsFOG Colfogger

Facts and Data about Fogging



K-30-STD K-22-STD K-10-STD K-10-SP



K-30-20-BIO

Performance table

Type	K-10-SP	K-10-STD	K-22-BIO	K-22-STD	K-30-STD	K-30-20-STD	K-30-20-BIO	Trac FOG	Col fogger	Turbo ULV	Observations
Weight, empty kg	7,1	8,5	11,6	10,4	13,3	15	16	230	150	6,6	K-10 to K-30 portable
Capacity of solution tank(L) Capacity of water tank (bio)	5	9	5 5	9	9	55	55	100 400	100	5	Tanks detachable for refilling and cleaning
Max. fuel (power) consumption (Amps) L/h	1,9	1,9	3,8	3,8	7,6	7,6	7,6	NA	16 / 25 A	4,6 A	Fuel consumption varies due to adjustable speed
Combustion chamber volume Max.gross engine power HP kW kcal/h	300 cm ³ 24,1 17,5 15 300	300 cm ³ 24,1 17,5 15 300	1 l 50,8 37,4 32 200	1 l 50,8 37,4 32 200	2 l 101,6 75 64 400	2 l 101,6 75 64 400	2 l 101,6 75 64 400	min.15	6 / 8	1,0	Power is calculated from the fuel consumption TracFOG: minimum power of engine
Dosing nozzle (water+VK2) Dosing nozzle for flowers Dosing nozzle for water fog Dosing nozzle for water tank	1x0,8 1x0,7 1x0,7	1x0,8 1x0,7 1x0,7	2x1,1 2x1,0 2x0,9 2x0,8	2x1,1 2x1,0 2x1,0	2x1,3 2x1,2 2x1,1	2x1,3 2x1,2 2x1,0	2x1,2 2x1,1 2x1,0		1,3	2 0,7 0,8	These nozzles ensure a droplet spectrum of 1-30 µm
VMD (with water + VK-2) µm	20	20	20	20	20	20	25	25	25	variable	With water + VK-2 Spezial
Average flow rate* (L/h)	12	12	25	30	60	60	90	100	20	5	With medium sized dosing nozzles
Effective throwing range with nutriFOG® or VK-2 Spezial (m)	25	25	40	40	60	60	60	50	30	20	At a minimum of 3 m air space above the crop
Effective throwing range mit pure water (m)	15	15	25	25	40	40	40	40	30	15	At a minimum of 3 m air space above the crop
Surface area performance with VK-2 or nutriFOG® (m ² /h)	6 000	6 000	12 000	15 000	30 000	30 000	30 000	1-2 ha/h	4 000	2 000	Basis: 2 l / 1 000 m ² TracFOG: 5 -10l / 1 000m ²
Suitable for a greenhouse area up to (m ²) If individual greenhouses are not smaller than (m ²)	2 000 100	2 500 100	5 000 300	5 000 300	7 500 500	10 000 500	10 000 600	> 10 000 1 000	500 – 10 000 200	2 000 50	

* flow rate depends on the formulation viscosity (WP or EC), the level in the tank and the nozzle size used. Data show an average flow rate



Turbo ULV with adjustable nozzle



TracFOG 100

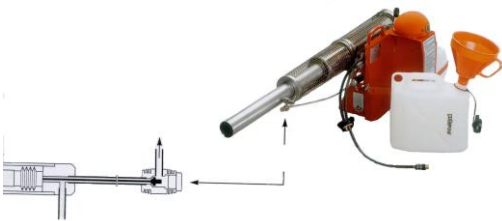


Colfogger

Useful Accessories

- (1) pulsFOG® light protection suit
- (2) Horticulture mixing set, including:
1 x 2 l graduated measure
1 x 250 ml-graduate measure
1 pair of chemical resistant rubber gloves
1 x wooden stirrer
- (3) 5 l cleaning kit
- (4) Fuel measure
- (6) Solution funnel, small
- (7) pulsFOG® tool bag
- (8) Cleaning drill for nozzle
- (9) Gas mask with filter A₂B₂-P₃
- (10) Cleaning brush
- (11) Ear protection
- (12) Spare parts set, small
- (13) Spare parts set, large

Optional automatic cut off device
for the fogging solution to prevent wrong operation during application



Success with the pulsFOG® fogging method:

- **Full-scale interior treatment** leaves concealed pests without a chance.
- **No spraying stains** which might deteriorate valuable crops.
- **Working time savings** up to 90 % means improved conditions for preserving health and increased competitiveness.
- **Improved environment protection!** Aerosols do not run off into soil as cohesive liquids do. They neither trickle from the foliage nor penetrate the soil. Soil fauna and ground water are protected. The fogging technique leaves no residuals in fogging tank, which are often disposed of carelessly.
- **Quick degradability** on vegetable crops due to more even dispersion of the droplets ensures consumer protection.



International experts reports about the pulsFOG® fogging method:

IDEA CAME FROM V-ROCKET

2000e PULSFOG-GASNEVELAPPARAAT GEÏNSTALLEERD

Dat de Pulsfog-Gasnevelapparaten bijzonder nuttige en kwalitatief hoogstaande apparaten zijn gebleken, die zich een vaste plaats op de moderne tuinbouwbedrijven hebben weten te veroveren, werd deze week nog eens duidelijk, toen de firma Brinkman uit 's-Gravenzande de 2000ste PULSFOG afleverde op het bedrijf van de gebroeders Spruit aan de Anjerweg 10 te Bleiswijk. Deze 2000ste aflevering gepaard met overhandiging van een oorkonde en de aanbidding van een seizoen gratis VK-draagstoffen.

Ongeveer 10 jaar geleden heeft BRINKMAN BV te 's-Gravenzande de eerste contacten gelegd met dr K. H. Stahl GmbH in Duitsland. Door de levensgrote problemen met de witte vlieg, was de noodzaak aanwezig om dit suavel aan te pakken met alle mogelijke middelen. Na enkele proeven bleek al snel dat met de Pulsfog K10 een goede bestrijding mogelijk was. De beschikbare middelen op dat moment waren: Dedevap, Phosdrin, Brigog en Undeen spry. Deze middelen waren met VK-1 draagstof uitstekend te verwerken. Ande-

Tuinster Spruit Pulsfog en de o

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FOGGING UNDER GLASS—SPECIAL REVIEW

This cheap and flexible method of fumigation may have strong future

A SPECIAL CORRESPONDENT reports

LIKE MANY other so-called "new" horticultural techniques fogging machines have been around for some time. The pulse jet principle on which three makes of machines operate has its origins in the second world war V1 rocket unit. It was in the mid '50s that "foggers" first appeared on the UK glasshouse market. They required specially formulated chemicals and the range of those was limited.

The pulse jet principle is a simple one. In a combustion or explosion chamber a sparking plug fires a fuel/air mixture. The gases travel down an exhaust tube. The resulting drop in pressure brings in a fresh mixture through a non-return valve. The fuel/air mixture fires again and again the hot exhaust gases move down the tube. In this way until turned off the chemical is fed into the high speed gas flow at the front of the exhaust tube and is broken into small particles which are propelled into the atmosphere as a dense fog.

More powerful machines

Since their early days there has been considerable development in the machines themselves. This has taken the form of more powerful machines suitable for dispersing wettable powders through large glasshouses and in some

ing down through the crop. There is no increase in humidity. Fogging is best carried out in the evening and the advantages of leaving the plants dry are obvious. Carrier solutions make it possible to fog a wide range of insecticides.

SN 11, is nearly 4ft. in length, has an output of 2.2 to 6.6gal. per hour and costs £269. Standard accessories include flow control jets, carrying strap, filling funnels and spares.

Guerneux enthusiasts

Special Fertilizer for the Fogging Method in the Greenhouse

nutriFOG® is a proprietary and registered special formulation, offered for pulsFOG® thermal and cold fogger with stainless steel nozzles. It retards premature evaporation of the water and prevents the fertilizer substance from crystallizing*) out prematurely. nutriFOG® contains all the essential nutrients for improving the plants' vitality, thus ensuring a particularly attractive appearance of the treated cultures. The nutrients can develop their full physiological effect due to the added chelating agents. nutriFOG® is suitable for admixing to common plant protection applications, too.

Dosage:

250 ml of nutriFOG® plus 1.5 –2.5 l of water per 1.000 m² of greenhouse area at an interval of no less than 5 days. Increasing the dosage to 500 ml/1.000 m² is possible in individual cases. The total application volume of nutriFOG® should not exceed 1.5 l/1.000 m² per month. If wettable powders are admixed, the concentration should not exceed 80 g WP/l of water. If necessary, add more water. Please observe the dosage on the label of the plant protective product and the instructions of the fogger manufacturer.

Preparing the fogging liquid:

Start by mixing the treatment agent with water, then add nutriFOG® while stirring. If an inexperienced biocide is intended to use, it is advised to prepare first a small trial solution to check the compatibility. In some rare cases the mixture is not compatible (it will develop a paste). Do not mix nutriFOG® with biocides, which prohibit adding any other chemicals.

Application instructions:

For combined application with plant protectives, wear gas mask with filter A₂B₂-P₃

Distribute the fog evenly on the crop while walking backwards. Stationary fogging is only admissible with fan-type foggers or additional fans using a fan with low revolution (less than 1000/min). Machines, equipped with a nozzle system made from brass are not suitable (brass is not resistant to nutriFOG®). Operate and fog only in the evening, avoiding strong temperature drop during the night.

Prevention of accidents:

Do not enter the treated greenhouse during the period of action of the fog and vent it for one hour before entering.

Precautions:

Keep the treatment substance and its residues as well as the emptied Containers and packages away from waters. Fully use up any residual quantities. Dispose of empty packages via the household garbage collection, or rinse thoroughly. After work, wash the hands and all affected skin areas thoroughly with water and soap. In case of eye contact, rinse immediately with ample water. In case of sickness or accident, call a physician immediately (if possible, present this label to him).

Danger: Misuse may be detrimental to health. Swallowing is detrimental to health.

Storage:

Store in original Container. Keep out of the reach of children and away from human and animal food. Protect this product from drying out, contamination and sunlight. Keep the Container hermetically closed. Do not store at temperatures below 4°C and higher than 40°C.

Liability:

This Information corresponds to the current state of our knowledge and is intended to inform you about the possibilities of application. The product is suitable for the recommended purposes if these instructions for use are observed. Since storage and application of the fertilizer are beyond our control, we shall only warrant perfect quality at the time of delivery.

*) Fertilizers are originally dry crystals, which have to be dissolved in water for a proper absorption in the plant. A foliar fertilizer formulated for the traditional foliar spray (high volume) is not suited for any ULV application (thermal or coldfogger), since the small droplets containing the diluted crystals would evaporate within few minutes. The water content of small droplets evaporates before settling on the foliage and the remaining fertilizer crystals will arrive the leaves without being absorbed.

nutriFOG[®] (EEC fertilizer)

NPK fertilizer solution with B; Cu; Fe; Mn; Mo; Zn

10%	N	total nitrogen
3%	P ₂ O ₅	water-soluble phosphate
3%	K ₂ O	water-soluble potassium oxide
0.01%	B	water-soluble boron
0.002%	Cu	water-soluble copper*
0.02%	Fe	water-soluble iron*
0.01%	Mn	water-soluble manganese*
0.001%	Mo	water-soluble molybdenum
0.002%	Zn	water-soluble zinc

* as a chelate of EDTA (low Chloride content) Do not store at temperatures below 4°C and higher than 40°C. Avoid strong temperature Variation.



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