Importance of Gnat Control in avoiding Phytophthora, Pythium, Fusarium and other Root Diseases in Hydroponics and Nursery Production.

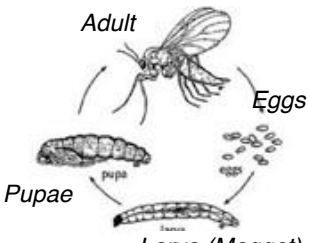
Typical Gnat Adult

Some years ago, as a result of observations in NSW, Australia it was found that gnats (fly like insects smaller than sandflies) were responsible for spreading Pythium in hydroponics crops. In New Zealand and USA it is evident that other Diptera (flies) can also be responsible for introducing and spreading several fungi. These Diptera include Gnats, Shore Flies and related insects that spend some of their life cycle in streams, ditches and flooded areas, selecting these sites for laying their eggs. The adults migrate into sheltered often warmer areas from late winter to autumn carrying organisms that can cause serious diseases and crop losses. The organisms carried include many bacteria, *Pythium spp, Phytophthora spp* and *Fusarium spp*. The insects seek out wet areas found in or near green houses (under benches where drainage waters may be present, in damp seed raising areas, in flood and drain tables, on capillary matting, in rock wool cubes and slabs, under leaking joints in hydroponics systems, in areas where gullies and trays are washed or hosed) to deposit their eggs. They carry pathogens on their bodies, and in some cases internally, into the growing media or circulating hydroponics nutrient solutions. They have also been implicated in spreading bacteria of the soft rot organism from decaying foliage of Callas to clean plants. They are attracted by the smell of the disintegrating infected leaves. It is also likely, as they move from infested to clean areas, that they transfer Pseudomonas bacteria responsible for heavy losses on many herbaceous and woody plants.

Gnat maggots on composted bark media
Photo credit: B Marks

Since gnats are known to cause problems it is logical to assume that larger organisms may also do this and evidence is available that the same pathogens are spread by slugs and snails, various frogs (that often live within hydroponics systems) cats, dogs, and of course humans. These are not considered here but it may also be worthwhile considering the part that other organisms may play in spreading pathogens and limit as far as possible their involvement.

As well as spreading pathogens the eggs of Gnats hatch to the first immature stage of the adults which are small white maggots that feed on the roots of plants. They grow in size and the larger maggots may burrow into the roots causing sever injury and when large numbers are present cause serious losses of yields and crops. At the latter stages of their development the maggots are readily seen in media and about the plant roots. *(See photo above.)* Following pupation the adults emerge. If this occurs in the green house the situation is serious since numbers will be high and the adults will be carrying any pathogens that may be in the system. Adults entering from muddy areas outside are the source of pathogen introduction into the green house. The presence of Gnats is sometimes first noticed by the large number of small black spots (droppings) on seedling and lower plant leaves.



Shore Fly

Insecticidal control of the Gnats and related insects is limited by the pesticides that can be used on food crops. Many growers of salad crops do not use

insecticides. Non-food crop situations are easier to manage. Several strategies are described below to eliminate or reduce the number of these problem insects in the green house.

Monitoring Adult Populations.
Yellow sticky traps are available from Pure Hydroponics in small rectangular sheets or 100 metre rolls to detect the start and end of flights of the adults.

Control of Adult Gnats and Small Flies in Green House areas.
It is important to eliminate resident populations in the green house since these have immediate access to plants and the nutrient. They seek moisture and lay their eggs that will continue the cycle inside the house. Control can be achieved by the use of residual and knock down insecticides applied to areas where the insects congregate such as under benches in areas especially where there are leaks, on green house structures where they may congregate and in the air where they may be found in groups 'milling about'. Those flying around may be in localised areas and a domestic aerosol type fly spray can help.

Many insecticides will give control so long as drifts do not contact plants. (Details given below). If still on hand use first any stock of diazinon on structures and floors. Cypermethrin (e.g. Ripcord™ and others) are available as EC formulations that have leave a residue that, when applied to structures, will remain active for several weeks. Fendona™ is a lower cost suspension concentrate of the same active ingredient and is possibly longer lived. It is registered for use about but not on crops. (Follow label directions).

Most other insecticides used for aphis control will knock down adults.

Control near Houses.
Many infestations that arrive in green houses are the result of activities related to the greenhouse and crops growing in them. Inspect areas where waste water is discharged and may pond. Eliminate these area. Pay particular attention to infestations near seed raising and propagation areas since infestations there can result in large numbers of plants becoming infected and may cause near complete crop losses.

The best control method is to avoid all ponding by improving drainage. If unavoidable flooding occurs at any period treatment of the area with environmentally compatible insecticides may give short term control. Ensure that greenhouse floor drain pipes, to the exterior, are fitted with gully traps or other means that will prevent ingress of the adults through the pipes

Control of Maggots infesting crop roots.
At times it may be necessary to use insecticides within crops to eliminate the immature maggots or adults. Details are given below. It is very important to prevent spread in nursery and seed bed areas. During periods when adults are moving into houses maintain insecticides on surfaces where the adults settle. Use aerosol space sprays in evenings when entry from outside occurs. Watch for these occasions. Gnats enter into warm areas and to obtain shelter. Apply diatomaceous earth to media and seed beds as described below.

Diatomaceous earth.

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A useful tool for controlling gnats and shore flies, that transmit Pythium and other pathogens into hydroponics systems, is Diatomaceous earth. It is a chalky white to cream powder obtained from the natural fossilized remains of diatoms, a type of small hard-shelled ocean organism. These diatom particles are very small and sharp but only harmful to the small exoskeletons of insects. Insects cannot become immune to their action since it is a mechanical killer. Because it is a light dust, it clings to the bodies of all stages of the insects. Maggots may also ingest the powder. The tiny diatom particles then cut through the waxy coating or lining of the insects gut and they eventually dry out and die.

Seed beds, especially those that use capillary matting, composted bark, rock wool or vermiculite, can be liberally dusted with **diatomaceous earth**. Use a "pepper pot" technique to liberally coat the media as seedlings are about to emerge. If washed into media during irrigation it will eliminate maggots as they hatch from eggs and will maintain its activity when plants are transferred into hydroponics systems. Also spread about any areas near the houses where gnat adults, larvae (maggots) or pupae may be present.

Diatomaceous earth is available from Pure Hydroponics. Some lines of diatomaceous earth, used for insulation in walls etc, have been heat treated to reduce abrasive properties. Do not use products that have been heated since they do not abrade the insects' exoskeleton.

Diatomaceous earth contain a variety of elements and usefully contribute to the supply of silica, that is used in plant roots and leaves. Supplies of this element can be low in hydroponic systems.

Sawdust A 1 cm layer of fresh pine sawdust applied to the tops of media in pots or bags repels the insects and may be useful in some situations. Coriander oil is also a useful repellant but vaporises too rapidly to provide more than a few days control.

Suitable insecticides for Green house uses
Most contact insecticides will control these insects. Systemics are only effective by contact (when being applied). Vapour active insecticides are effective as knockdown sprays.

alpha-Cypermethrin (e.g. Fendona™ SC and Ripcord™ EC)
A useful low cost material for use about the green house and gullies is **Fendona.** (This is also sold for domestic use as Ripcord Plus™.) This is the same active ingredient as **Ripcord EC**. If Gnats have a favourite place to congregate in the house these formulations can be applied as residual materials. They are also useful when applied where there are leaks and under benches. Not for direct application to many food crops including lettuce. See labels for limitations. (EC formulations sometimes cause injury on soft crops.)

Imidacloprid (e.g. Confidor™, Gaucho™)
Care is required to avoid excess residues on plants. Follow label directions. These insecticides, when used as a spray for aphis control, will also control gnats by contact. Not effective on adults when used as systemics added to the nutrient solution (where permitted).

Domestic Fly Sprays
Most fly sprays are effective and when used as aerosols and they can be applied as space sprays to areas where the insects congregate, often in the evenings. Useful in seedling

areas. Avoid use where residues may result on crops close to their harvest.

Insecticides to control Maggots in media and Hydroponics Systems.
Vectobac™ contains a selection of a natural bacterial 'spores' that contains the toxic material. It has action on Diptera (fly) larvae (maggots) and some caterpillars. To be effective it needs to be ingested by the maggots or caterpillars. It stops them eating and they die. This takes about 5-7 days so kill is efficient but slow. It has a very low toxicity and when applied to edible plant parts generally has a nil or 1 day waiting period. Confirm details on the label if you are applying it to salad crops after the nursery nursery stage.

Two formulations are available:
Vectobac 12AS™ is an effective and safe (BT) liquid formulation (1200 ITUs) for incorporating in the media/rock wool etc. to control the gnat larvae. Use 1.2 to 2.4 ml to 10 sq m as a spray applied to the media/rock wool and then water in. Repeat at 7-10 day intervals if adults persist to lay eggs. It can also can be added to the nutrient tank using up to 2.4ml/10 sq m of bed area for lettuce and similar crops. If the area of the green house is taken, and reduced by 30% for walkways etc, this is a figure that can be used as the cropped area.

Vectobac WG™ is a water dispersible granule (3000ITUs) that can be added to the main nutrient tank using up to 1g/10 sq m, using the above as the basis for crop areas. For nursery beds, just add 1g for each sq m of bed. If it is more convenient it can also be sprayed across the beds using the same rate.

Effective Disease Control.
For effective control of disease remember that controlling Gnats and other Diptera, and organisms that carry bacteria and fungi, is only one part of the overall disease control strategy. It is also essential to ensure that water supplies are clean and the hydroponics solution is maintained in a high health state. Water supplies may be disinfected with 2ppm Oxine™. Regular additions of phosphorous acid to the nutrient solution is also effective. For export crops ensure that treatments used are acceptable to importing countries since variations in approved residue limits occur.