

The Development of Fipronil for Vine Weevil Control in the U.K.®

Alan Horgan

Certis UK, 1b Mills Way, Boscombe Down Business Park, Amesbury, Wiltshire, SP4 7RX, U.K.

Vine weevil, *Otiorhynchus sulcatus*, causes up to £30 million worth of damage in the U.K. ornamentals market. In 2002 the insecticide fipronil, sold as Vi-Nil, was introduced for compost incorporation. It belongs to the phenyl pyrazole insecticide group, which shows no cross-resistance with existing insecticides. An outline of its practical use is given along with suggested reasons for its rapid adoption by U.K. growers. Experience with its use to date is briefly considered. Finally, recent developments associated with long-term protection and sciarid fly control are explained.

INTRODUCTION

Black vine weevil, *Otiorhynchus sulcatus*, can be found in Europe, North and South America, and Australia. Only in central Italy are sexual forms of *O. sulcatus* present and one leading expert, Max Barclay (pers. commun.), believes that the Romans were guilty of introducing it to the rest of Europe where it has a self-fertilising, parthenogenic form. This form is the one that has spread through trade to the rest of the world.

Since Roman times other species of vine weevil have been introduced to the U.K. Recent examples are *O. armadillo* and *O. salicicola*, which made national headlines in 2002. It is thought that their appearance was due to imported plant material from southern Europe. Both species reproduce sexually in the U.K. Time will tell whether they will become established in U.K. Expert knowledge is required to distinguish between these different species.

Vine weevil is a serious pest in ornamental plant production. Damage is associated with feeding on roots by the larval stage and on foliage by adults. The cost of vine weevil damage has been estimated at £30 million in the U.K. ornamentals market, and if strawberry production were included the figure would be much higher. The cost to individual growers can be considerable if their nursery reputation is tarnished by the appearance of vine weevil larvae in crops supplied to customers. Garden centre consumers are quick to complain when plants fail to establish in their garden and they subsequently discover vine weevil grubs in the compost.

FIPRONIL DEVELOPMENT

Preventative control has been the principal measure against vine weevil in the U.K. Aldrin, before its approval was revoked in 1989, was used as a preventative insecticide mixed into compost. Chlorpyrifos has since been an alternative method of control.

The insecticide fipronil was discovered in 1987 by Rhone-Poulenc, now Bayer Crop Science, at its Ongar research station in Essex, U.K. Fipronil is registered in more than 60 countries for at least 50 different crop uses. Its effectiveness and safety led to its first uses being developed in veterinary medicine and public health.

Since 2002 it has been available to the U.K. ornamentals market as Vi-Nil, marketed by Certis (formerly Hortichem).

The worldwide success of fipronil has been based on its broad-spectrum activity, ease of formulating the active ingredient, and safety to operators and the environment.

MODE OF ACTION, SELECTIVITY, AND RESISTANCE STATUS

Fipronil belongs to the family of nerve toxin insecticides called phenyl pyrazoles which interfere with the passage of chloride ions through the gamma-aminobutyric acid (GABA) — regulated chloride channel of nerve cell membranes. This disrupts central nervous system activity and, at sufficient doses, causes death to the target organism. There is strong target site specificity between insects and vertebrates, with fipronil displaying tighter binding — and therefore greater potency in the insect GABA chloride channel than in the mammalian one. Safety is therefore based on a much lower dose being required to kill target insects than that which will affect mammals.

While other groups of insecticides affect the insect central nervous system (e.g., pyrethroids, carbamates, and organophosphates), no other insecticide has this specific effect. Fipronil can therefore control insects resistant to these groups of chemicals. Fipronil is regarded as having a low resistance potential and shows no cross-resistance with organophosphate, carbamate, or pyrethroid insecticides that are normally used in U.K. horticulture.

PRACTICAL USE OF VI-NIL IN THE U.K.

Vi-Nil is a mini-granule formulation containing fipronil, which gained U.K. approval in June 2002 for use in container-grown ornamental production. The label specifies incorporation of the mini-granule at $1 \text{ kg} \cdot \text{m}^{-3}$ (or more practically, 80 g of the mini-granules per 80-L bag) of growing medium. It specifies use on all substrate types including peat, peat/bark, and other mixed media.

The use of gloves and dust mask are required for mixing, but gloves are not required when handling treated media. The label states that treated media should be used within 12 days of mixing. However, trials have since shown stability for at least 33 days after mixing. Efficacy data exists showing control where plants have been growing in treated media for at least 2 years (see below).

Growers should refer to the product label for full details before using Vi-Nil.

Efficacy Against Vine Weevil. During product development 19 fully replicated trials showed consistent results over a range of crop species and under different growing conditions. Only 1 g of active ingredient is needed per 1 m^3 of compost.

Field experience and a more recent fully replicated trial (described below) have shown that vine weevil protection can be achieved for at least two seasons. This can be very important for valuable plant subjects such as rhododendrons and azaleas that can take a long time to reach a saleable size, or the increased trend to market patio-ready full-size plants. It is also useful in providing protection right through the plant cycle from plug to the final marketing of the container.

Fipronil carries no anti-feedant effect, so vine weevil larvae are not discouraged from ingesting the compound and thereby taking in a lethal dose of active ingredient. Once ingested the effect on the insect is irreversible.

Formulation Benefits. The size of the mini-granule means it is easy to mix to achieve good, even distribution throughout the growing medium while the formu-

lation provides at least two seasons of control. The active ingredient is gradually released from the granules and it then binds onto the root system of the crop. Any larvae grazing on the roots quickly take up a lethal dose.

Preventative treatments such as Vi-Nil will eradicate the pest prior to damage, so encouraging root development in the absence of damage. Growers have commented on the ease of use of Vi-Nil and that the grey/white granules become less obvious over time, and are unlikely to be noticed by, or to worry, end customers.

Growers can ask their substrate suppliers to pre-mix Vi-Nil in their growing media orders. This may be convenient to both large and small nurseries where time and skilled labour may be in scarce supply.

Other Pests That May Be Controlled. Sciarid fly can be reduced when using Vi-Nil in the propagation medium and recent experimental results have supported this view. Where high pest pressure is likely to occur, then additional controls, such as the biological agent *Hypoaspis* sp. may be required.

It is assumed Vi-Nil will have some activity against leatherjacket, shore flies, and wireworm.

In Vi-Nil trials, anecdotal comments have been made about the reduced incidence of root diseases such as *Pythium* and *Phytophthora* when the product is used. It is unclear why these additional effects have occurred when comparing crops grown in Vi-Nil-treated media with untreated crops. It may result from a reduction in root damage — and hence fewer entry sites for pathogens — from insect pests not previously considered to be of economic significance.

Crop Safety. Both field trials and commercial use have clearly identified more than 100 ornamental species that can be safely treated with Vi-Nil. In one trial, no damage occurred to unrooted poinsettias in Vi-Nil-treated media even at four times the normal recommended dose. Another area investigated was to check that treated mother plants would continue to produce normal cutting material. No adverse effect was observed in these trials.

Safety to Beneficial Organisms and Biological Control Agents. Intensive trials have shown that Vi-Nil has little or no impact on beneficial insects, including earthworms and soil microorganisms. Because it is incorporated into growing media it will have limited exposure to other beneficials. It has been shown to be safe to spiders (*Lycosa* sp., *Erigonidium* sp., *Oedothorax* sp.) and predatory bugs (*Cyrtorhinus* sp.). When used according to the label Vi-Nil has no effect on bees. When incorporated into growing media, Vi-Nil produces no volatiles that might affect *Encarsia formosa* introductions.

Vi-Nil users commonly ask about its effect on biological controls such as nematodes or *Hypoaspis* sp. applied to treated media. In practice, Vi-Nil has been found to be safe in integrated pest management (IPM) programmes.

Operator Safety. Safety is paramount for the success of a new insecticide and fipronil has clearly been identified as being safe to the user. In fact, fipronil is used in Frontline, a veterinary product used for controlling fleas on cats. The cats can be handled as soon as the spray treatment is dry. The toxicity profile for Vi-Nil is equally safe for the compost-mixing operator. Standard precautions are stated on the label. Wearing gloves and a disposable filtering mask are required when mixing. Once the compost is treated normal handling procedures can be used and no protective clothing is required.

Environmental Safety. Vi-Nil is effective at very low doses. One cubic meter of treated compost contains only 1 g of active ingredient. Once the fipronil is released from the mini-granule it is relatively insoluble in water. It is highly unlikely to enter ground water sources. Its adsorption on to soil and associated low solubility will also reduce the chances of aquatic life being affected by fipronil. Bird exposure is unlikely given its normal method of use and studies have found that birds find fipronil unpalatable.

EXPERIENCE OF TWO SEASONS USE OF FIPRONIL

Vi-Nil adoption within the ornamentals industry has been rapid both by individual growers and by growing media manufacturers. Word of mouth reports have certainly helped to establish this product within this sector.

Concerns about new species of vine weevil in the U.K. have heightened the awareness of the threat from this pest. This factor and the need to produce plants free from vine weevil infestation have highlighted the need for preventative treatments. Waiting for damage to occur and then providing a curative treatment is regarded as counter-productive.

Increasing confidence with the product has meant that more and more growers are starting to use it to prevent infestation from propagation to the final potting on stage. Nil tolerance pest specifications from buyers will make this approach essential for successful ornamental production.

RECENT DEVELOPMENTS

Long-Term Vine Weevil Control. The Agrochemex ran a fully replicated trial from 1999 to 2001 using container-grown *Thuja* and inoculating the pots with vine weevil eggs. Treatments and results are summarised in Table 1. The researcher concluded that fipronil provided nearly perfect control of a second generation of larvae where the other materials tested showed little sign of efficacy in the second season of the trials (Parsons, 2003).

Table 1. Long-term performance of three insecticides against vine weevil larvae (mean results per pot, potted and treated 30 April 1999).

Treatment	Active ingredient per m ³ (g)	Feb 2000		Jan 2001	
		Larvae	F. wt. (g)	Larvae	F. wt. (g)
Control	0	5.3	15	4.4	14
Vi-Nil	1	0.0	16	0.3	71
Chlorpyrifos	100	5.8	31	9.5	57
Imidacloprid	14	2.0	30	6.7	27

Direct Sticking of Cuttings and Sciarid Fly Reduction. Tables 2 and 3 show some interim results from a trial using *Lavandula angustifolia* (syn. *L. 'Vera'*) cuttings inserted into Vi-Nil-treated growing medium. Table 2 shows the numbers of dying plants which may have been attacked by sciarid fly larvae and Table 3 shows the numbers of adult sciarid flies arising from the compost after the tops of the plants were removed. These indicate the safety of Vi-Nil on cuttings and efficacy

against sciarid flies. Where Vi-Nil and imidacloprid have both been used in the same medium, which is sometimes practised by growers to control whitefly as well as sciarid fly and vine weevil, plant safety has not been compromised.

Table 2. Number of dying *Lavandula angustifolia* cuttings per plot of 40, assessed 44–45 days after sticking.

Treatment	Active ingredient/m ³ compost	Mean number of dying plants
Control	0	10.25
Vi-Nil	1 g	2.5
imidacloprid	14 g	6.75
chlorpyrifos	75 g	5.0
Vi-Nil+imidacloprid	1 + 14 g	3.5

Table 3. Number of adult sciarid flies caught on yellow sticky traps (0–7 days after cutting off the tops of the plants).

Treatment	Active ingredient/m ³ compost	Mean number adult sciarid flies
Control	0	21.75
Vi-Nil	1 g	6.25
Imidacloprid	14 g	19.75
Chlorpyrifos	75 g	15
Vi-Nil+imidacloprid	1 + 14 g	6.25

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LITERATURE CITED

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