Frequently Asked Questions and Answers for Nimitz® Nematicide

What is Nimitz®?
Nimitz® is a contact nematicide applied prior to transplanting seedlings of Tomatoes, Capsicums, Chilli, Eggplant, Okra and cucurbit vegetables. It is intended for use in fields where nematode damage is preventing growers from reaching the full potential of a crop, whether fields were previously untreated or as replacement for current nematicides. Nimitz® provides an unmatched combination of safety and efficacy, thereby simplifying several aspects of nematode management.

What is fluensulfone?
Fluensulfone is the active ingredient in Nimitz® - a new molecule from a new chemical class known as heterocyclic fluoroalkenyl sulfones.

Who discovered fluensulfone and when?
Fluensulfone was discovered in Japan and quickly showed significant promise for use as a replacement to outdated carbamate and organophosphate nematicides. The development project was taken on by Adama (formerly Makhteshim-Agan) in 2006 and now after thousands of trials conducted in 23 countries over all continents, fluensulfone has consistently demonstrated equal or better nematode control when compared to the best commercial standard.

Is Nimitz® a fumigant like some other nematicides?
Unlike some older chemistry, Nimitz® is not a fumigant. The active ingredient is distributed through the soil and into contact with nematodes through water movement via irrigation or rainfall following application.

Is Nimitz® already registered and in use around the world and if so, which countries and in what crops?
In the future, which other crops is Nimitz® likely to be registered for use in?
Nimitz® is now registered in the USA, Israel and Australia for use prior to transplanting solanaceous and cucurbitaceous crops with other countries also working toward registration including Brazil, Canada, Japan, South Africa, India and many others. It is under development both here and overseas with other key crops in Australia likely to include Potatoes, Sweet Potatoes, Carrots, Sugarcane, Pineapples, Citrus, Grapes and others.

Nematodes

What is a nematode?
Nematodes are microscopic organisms also known as ‘roundworms’ or ‘eelworms’. Nematodes may be microbivorous (feeding on bacteria or fungi), predaceous (feeding on nematodes and other small animals), entomopathogenic (feeding on insects) or plant-parasitic (feeding on plants).

Would I know a nematode if I saw one?
Nematodes can’t be seen by the naked eye. They live in the free water that surrounds soil particles but even though they are microscopic, some nematodes can move up to a metre in soil in a year. They are attracted to the root exudates of plants and can migrate from untreated areas in between rows into the root zone during the growing season.

How will I know if nematodes are a problem for me?
The most prominent nematode pests of vegetable crops locally are members of the Meloidogyne genus. In Australia, there are five relatively widespread Root-knot nematodes (RKN) including M. javanica, M. incognita and M. arenaria in warm climates and M. hapla and M. fallax in cool climates. RKN juveniles enter plant roots which induces root cells to expand and form “giant cells” on which the RKN feed. The giant cells enlarge and visible galls are formed from tissue that surrounds these cells. These galls can be seen if you remove an affected plant and inspect its roots.

Galls disrupt the xylem vessels and the roots cannot function normally with respect to water and nutrients, resulting in above ground symptoms of nutrient deficiency and/or disease and most likely poor irrigation efficiency and yield loss.
The use of nematode monitoring techniques is an important step in understanding what threat RKN pose and what action to take. Manual testing can be carried out using traditional sampling techniques and laboratory analysis or using SARDI Predicta Pt test (DNA extraction). RKN populations detected should then be compared to acceptable thresholds and a management action plan implemented if required. Fields should later be re-sampled to check that the control measures have been effective.

**Using Nimitz®**

**How does Nimitz® control plant-parasitic nematodes?**
The fluensulfone in Nimitz® acts quickly and within 1 hour of contact, target nematodes cease feeding and quickly become paralysed. Within 24 - 72 hours complete mortality is achieved, rather than nematostatic or temporary paralysis. Unlike activity seen when using current organophosphate and carbamate chemistry - which allows nematodes to ‘unfreeze’ when the nematicide passes through the soil profile in time – the action of Nimitz® is irreversible.

**Why is the 480 EC formulation chosen for Australia?**
We have chosen an Emulsifiable Concentrate liquid in Australia for its effectiveness and to allow Nimitz® to be simply applied as per current practices for many growers here. Nimitz® is likely to be available in several formulations around the world, engineered to accommodate local agricultural practices in different crops and countries.

**Is Nimitz® safe to users and the environment?**
Nimitz® is scheduled as an S6 Poison meaning it does have to be treated with respect when handling the product, but does not require the Personal Protective Equipment which is mandatory when applying alternative S7 Dangerous Poison nematicides. Nimitz® has a very favourable toxicological and ecotoxicological profile and is considered non-toxic to birds, bees and aquatic life.

**Is there a minimum re-entry interval when using Nimitz®?**
The REI when using Nimitz® is 12 hours as opposed to 48 hours for Metham sodium, Vydate* and Nemacur* and 5 days for Telone†.

**Which nematode life cycle stages does it affect?**
Nimitz® affects all active stages of the nematode life cycle by inhibiting the feeding and motility of adults and juveniles and the laying, hatching and development of eggs.

**Is soil temperature a factor to be considered when applying Nimitz®?**
Nematode species become active at different soil temperatures. *Meloidogyne incognita* becomes active when soil temperatures reach 15.6 °C. Below this temperature, the immobile nematode does not absorb Nimitz® and may not be affected. Soil temperatures should be monitored, particularly in early spring when temperatures may be insufficient for nematode activity and thus reduce efficacy.

**Which nematode species will be controlled by Nimitz®?**
Whilst Nimitz® will initially only be registered for control of Root-knot nematodes, extensive testing has shown that many other species of plant-parasitic nematodes in Australia are susceptible including:

- Root-knot nematode - *Meloidogyne incognita*, *M. hapla*, *M. arenaria*, *M. fallax* and *M. javanica*
- Root lesion nematode - *Pratylenchus zeae* and *P. brachyurus*
- Golden potato cyst nematode - *Globodera rostochiensis*
- Cereal cyst nematode - *Heterodera avenae*
- Stubby root nematode - *Trichodorus spp*
- Citrus nematode - *Tylenchulus semipenetrans*

**What effect on other soil micro flora does Nimitz® have?**
Nimitz® is unique among nematicides in that it only targets nematodes without disrupting the balance of the soil ecosystem. Healthy, fully functioning soil is balanced to provide an environment that sustains and nourishes plants, soil microbes and other beneficial organisms. Managing for soil health is one of the most effective ways to increase crop productivity, profitability and sustainability.
How long does Nimitz® control nematodes for?
The aim of nematicide treatment for fruiting vegetables is to reduce the initial nematode population in the root zone and allow plants to develop a vigorous root system that can withstand later-season migration of nematodes without affecting crop yield or quality.

Nimitz® has been proven to control the nematodes in the treated zone long enough for crops to establish and thrive and to improve fruit yield despite later incursions from untreated areas. By significantly reducing early nematode damage, Nimitz® is able to increase yields in Tomato, Capsicum and cucurbit crops by 10 – 30% when compared to untreated crops, depending on the level of RKN infestation.

Does residual control last longer on lighter soils or heavier soils? Is pH a factor?
The half-life (DT50) of fluensulfone varies from 7 – 17 days, according to soil type. The length of effectiveness in light soils is slightly shorter than in heavy soils. The activity of Nimitz® is not affected by soil pH and there is no need to adjust the pH of water used to apply Nimitz®.

Resistance Management

What pressure is currently on nematicides in terms of resistance developing around the world and here in Australia? What is ‘accelerated degradation’ and how does it affect current nematicides in soil?

Whilst it is the generally held opinion that the development of nematode populations significantly resistant to existing nematicides and fumigants has not been observed under field conditions to date, the occurrence of ‘accelerated degradation’ of these compounds in soil has been well documented.

Accelerated degradation refers to the breakdown of these active ingredients and their metabolites at rates that are faster than those commonly seen and high enough to significantly reduce or totally eliminate the usefulness of the nematicide when applied to a particular soil.

Accelerated degradation may occur as a result of an increase in soil pH – when lime is applied to soil for instance – or via ‘enhanced biodegradation’ where microorganisms have adapted – after long term exposure through repeated applications to that soil – and are able to metabolise the product.

Whilst fluensulfone is not prone to accelerated degradation due to pH, in order to reduce the potential of Nimitz® efficacy being reduced by enhanced biodegradation, Nimitz® should not be used as the only nematode control measure and should be limited to one application per crop, with a maximum of 8 L/Ha in total per year.

Fluensulfone provides an important tool for the management of parasitic nematodes when used in an Integrated Management Strategy, and may assist in extending the usefulness of other traditional nematicides whilst they are still available.

Will Nimitz® form part of a Resistance Management Strategy?

As always, an integrated approach should be adopted to reduce the pressure on any one management practice. Relevant measures include the use of healthy seedlings (insect, pathogen and nematode-free), planting nematode resistant varieties when available, rotation with alternative crops that do not favour the survival of Root-knot nematodes, removal and destruction of volunteer seedlings from susceptible crops and other weeds, avoiding carryover of nematode contaminated soil between sites and the promotion of optimal growing conditions for the crop to increase tolerance to nematode infections.

For further information on management options and a copy of the booklet ‘Management of Root-Knot Nematode in Vegetable Crops’, visit adama.com or scan your QR reader below.
Compatibility

Which soil applied insecticides, fungicides and herbicides is Nimitz® compatible with if any?

Nimitz® may be applied in tank mixes with other products registered for application 7 days prior to transplanting Tomato, Capsicum and cucurbit seedlings.

The suitability of mixing partners should be considered carefully based on the timing of the Nimitz® application and the need for any subsequent irrigations to incorporate and dissipate the Nimitz® prior to transplanting.

Do not apply Nimitz® with any other product before testing for physical and chemical compatibility of the mixture. To determine compatibility, pour the recommended proportions of the product(s) into a suitable container. After mixing, wait 30 minutes and check to see if the product remains mixed. If the product remains mixed, it is considered physically compatible. Read and carefully observe the most restrictive labelling limitations and precautions of all products used in any tank mix.

Can I mix Nimitz® with liquid fertilisers? Will any mixtures have adverse crop effects?

A list of compatible mixing partners is presently being considered, however, due to the variable nature of some liquid and soluble fertiliser products, a physical compatibility test as above should be performed.

Also, the effect on efficacy of soluble fertilisers after application of Nimitz® and any subsequent irrigations to incorporate and dissipate the Nimitz® prior to transplanting should be considered.

Application Timing and Crop Safety

When do I apply Nimitz®?

Transplanted crops are most vulnerable just after planting, when the plant is not yet established and any damage to the roots can cause a delay in crop development or make roots vulnerable to disease infection.

Once parasitic nematode species have penetrated a root, control with any nematicide is more difficult. By applying Nimitz® to a well-prepared, weed-free bed 7 days prior to transplanting seedlings, growers are able to effectively target the pest.

Can I use my current application equipment?

Application is as simple as applying via sub-surface irrigation in the same way many other nematicides, insecticides and fertilisers are currently added. Alternatively, you can broadcast or band-spray with a boom – as you might with a residual herbicide – and then incorporate into the soil where the nematodes are and the seedlings are to be transplanted.

What rate of Nimitz® should I choose?

Based on extensive testing, a rate range of 4 to 8 litres per hectare of Nimitz® 480 EC is registered to control Root-knot Nematode. Suitable efficacy has been achieved with rates of Nimitz® at the lower end of the range when used under low to moderate RKN infestation in soils that have been prepared well in conjunction with a thorough nematode management strategy.

When RKN numbers are likely to be higher - or indeed have been tested and shown to have greater than 100 RKN per 200 mL of soil - it is recommended that the 8 L/Ha rate of Nimitz® is chosen.

A maximum of 8 L/Ha of Nimitz® may be used per year in any one treated area.

Which application method provides the best results in terms of nematode control?

The aim of any Nimitz® application is to create a nematode-free zone within the bed for the early-season root system to grow uninhibited by nematode attack. The most effective application method is therefore that which is capable of incorporating Nimitz® throughout this zone at the required use rate for the area being treated.

The application options for Nimitz® have been developed to accommodate preferred grower practice – which usually takes into account soil type, machinery available and irrigation method among other factors.

All application methods have been thoroughly tested and proven to be effective. However, when performed correctly, broadcast application followed by incorporation and bed-shaping - which pulls much of the treated soil and concentrates it in the raised bed at the correct rate - is perhaps the most effective means of ensuring that Nimitz® is distributed where it should be.
Does the Nimitz® stay in this area indefinitely? How long does it work for and what is its half-life in the soil?
Nimitz® has a half-life of 7-17 days in soil, so it does its job and moves on. This relatively short half-life is one reason why fluensulfone is ecologically friendly.

How do I calculate the amount of Nimitz® to be applied via Broadcast Application?
When a broadcast application is made, and beds are formed after incorporation, the rate applied should be reduced by the percentage of the area between beds. For example:
- 80 cm bed-top on 180 cm centres = 80/180 = 44 percent X 8 L/Ha rate = 3.6 L/Ha broadcast
- 100 cm bed-top on 200 cm centres = 100/200 = 50 percent X 8 L/Ha rate = 4 L/Ha broadcast

When incorporated correctly, the broadcast method gives the most accurate Nimitz® application rate for efficiency and reduces overexposure to the developing transplant. The ‘treated area’ used to calculate the applied rate is always less than the actual planted area due to the untreated inter-row.

How do I calculate the amount of Nimitz® required when using Drip Application?
Initial soil moisture must be at a level to allow the product to move uniformly from shoulder to shoulder and throughout the bed as it is being drip irrigated.

The calculation of rate for drip application is based on knowledge of irrigation efficiency/coverage of each drip system in a specific soil type. If a drip system is able to wet a bed “shoulder to shoulder,” then the same fractional formula described above for band application is to be used (calculate percent area treated using percentage surface area of the bed top). The drip-injection rate per hectare would be calculated based upon the bed width. If the irrigation does not wet the whole bed, calculation should be made according to the wet front width.

What if it rains after I have applied Nimitz® as a broadcast spray? Do I still need to mechanically incorporate it?
For optimal performance, all applications must be incorporated by water and/or mechanical means to a depth of 15 to 20 cm.

Soil moisture must be adequate for uniform mechanical incorporation and to support plant growth. While the amount of moisture will vary with soil type, irrigation or rainfall of 20-25 mm 1-5 days after application will increase movement of Nimitz® in the soil, thus increasing efficacy and crop safety.

Heavy rain that moves Nimitz® through the soil profile too quickly, or washes it away from the bed will reduce the efficacy of the application. Do not apply if heavy rainfall is expected within 48 hours.

When is the preferred application timing? Is it possible to apply too early – too far ahead of the planting process?
Trials have shown no significant difference in nematode control between applications of Nimitz® at 7 Days, 14 Days and 28 Days before transplanting. The interval of 7 days prior to transplanting has been chosen to allow time for adequate incorporation through the bed, sufficient time for Nimitz® to effectively treat the nematodes prior to introducing the seedlings and a safety buffer to eliminate any risk of seedling damage.

How quickly do I need to incorporate Nimitz® after broadcast or banded application to ensure that its nematocidal activity is not compromised?
Incorporation is best done immediately to ensure no lost efficacy. Individual circumstances will vary, but Nimitz® has been left for up to 5 days after application without significant loss in nematode control.

Which varieties of Tomatoes, Capsicums and cucurbits has Nimitz® been tested on and proven to be safe? Which varieties, if any, have shown unacceptable levels of damage?
ALL varieties of crops tested in ALL of the growing regions here in Australia have shown NO signs of phytotoxicity even when Nimitz® was applied at double label rates (16 L/Ha).

**Tomato varieties tested include:** cv 3002 (Buronga NSW), cv 3402 (Mildura VIC), cv Ivanhoe (Bundaberg QLD), cv Tiny Tim (Bundaberg QLD), cv Lava (Bundaberg QLD), cv Pinnacle (Bowen QLD), cv Pinnacle (Bundaberg QLD), cv Pinnacle (Alloway QLD), cv Pinnacle (Farnsfield QLD), cv Red Luck (Bowen QLD), cv Danika (Tenterfield NSW), cv Danika (Bundaberg QLD), cv Horsepower (Mildura VIC)
Capsicum varieties tested include: cv Husky (Bundaberg QLD), cv Merlin (Bundaberg QLD), cv Plato (Stanthorpe QLD), cv Plato (Bundaberg QLD), cv Plato (Mildura VIC), cv Warlock (Stanthorpe QLD), cv Warlock (Bundaberg QLD), cv Aquarius (Mildura VIC), cv Ducati (Bundaberg QLD), cv Ducati (Mildura VIC), cv Wizard (Bundaberg QLD)

Pumpkin varieties tested include: cv Ken’s Special Hybrid 864 F1 (Mildura VIC), cv Butternut large (Gunnedah NSW), cv Jap Improved (Stanthorpe QLD), cv Jap Improved (Gunnedah NSW), cv Queensland Blue (Gunnedah NSW)

Squash varieties tested include: cv Sunburst (Stanthorpe QLD), cv Sunburst F1 (Mildura VIC)

Zucchini varieties tested: cv Eva (Bundaberg QLD), cv Regal Black (Bundaberg QLD), cv Regal Black (Peats Ridge NSW), cv Nitro (Mildura VIC)

Rockmelon varieties tested: cv Eastern Star (Bowen QLD), cv Northern Sky (Bundaberg QLD), cv Northern Star (Farnsfield QLD), cv Argyle (Gunnedah NSW), cv Nepean (Gunnedah NSW), cv Sweetlife (Gunnedah NSW), cv Planter’s Jumbo (Stanthorpe QLD)

Honeydew Melon varieties tested include: cv Casper (Bowen QLD), cv Casper (Bundaberg QLD), cv Sweet Delight (Bundaberg QLD), cv Beethoven (Gunnedah NSW), cv Catalina (Gunnedah NSW), cv Ivory Star (Gunnedah NSW), cv Glacier (Bundaberg QLD)

Watermelon varieties tested include: cv Minipol (Bundaberg QLD), cv Red Tiger (Bundaberg QLD), cv Storm (Bundaberg QLD), cv Nightshade (Bundaberg QLD)

Cucumber varieties tested: cv Burpless Tasty Green (Gunnedah NSW), cv Camelot (Gunnedah NSW), cv Crystal Salad (Gunnedah NSW)

Since no varieties have yet shown adverse effects, even at 2X maximum label rates, and with many varieties tolerating up to 4X max label rates, we are confident that there will be few if any varieties that show ill-effects from Nimitz® when used according to the label directions.

Have the key varieties for other crops to be added to the label at a later date been tested yet?
The crops currently being trialled for future label use will receive the same varietal screening as done for the initial label, with a focus on the most significant varieties in each region.

Crop Withholding Periods and Plant-back Restrictions

Nimitz® has a long re-cropping interval restriction. Is this due to phytotoxicity to the following crop?
The existing plant-back restriction is not associated with phytotoxicity, rather, it is related to an absence of data at this stage for crop residues in subsequently planted crops that do not yet have an MRL for fluensulfone for their produce or that may be grazed by stock. Residue work is ongoing and once completed, restrictions are likely to be removed or significantly reduced but for now these plant-back restrictions must be strictly observed, and growers must sign a declaration that they understand these restrictions prior to their first purchase of Nimitz®.

Are any subsequently planted crops likely to suffer phytotoxic effects from Nimitz®? What crops are safe to plant after Nimitz® application?
No, as mentioned earlier, the half-life for Nimitz® is quite short and Nimitz® will not affect crops planted after growing a crop of tomatoes, capsicums or cucurbits treated with Nimitz®. Future Nimitz® labels are likely to have significantly reduced restrictions on what crops may follow crops treated with Nimitz® and what that re-cropping may be, but as mentioned above these plant-back restrictions must be strictly observed until such as time as these changes are approved.