Australian Government

Australian Pesticides and Veterinary Medicines Authority

Public Release Summary

on the evaluation of the active magnesium hydroxide in the product Booster-Mag 609 SC Insecticide

APVMA product number 89101

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Comments and enquiries regarding copyright:

Assistant Director, Communications
Australian Pesticides and Veterinary Medicines Authority
GPO Box 3262
Sydney NSW 2001 Australia

Telephone: +61 2 6770 2300

Email: communications@apvma.gov.au.

This publication is available from the APVMA website.

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Preface

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government regulator responsible for assessing and approving agricultural and veterinary chemical products prior to their sale and use in Australia. Before approving an active constituent and/or registering a product, the APVMA must be satisfied that the statutory criteria, including the safety, efficacy, trade, and labelling criteria, have been met. The information and technical data required by the APVMA to assess the statutory criteria of new chemical products, and the methods of assessment, must be consistent with accepted scientific principles and processes. Details are outlined on the APVMA website.

The APVMA has a policy of encouraging transparency in its activities and seeking community involvement in decision making. Part of that process is the publication of Public Release Summaries for products containing new active constituents. This Public Release Summary is intended as a brief overview of the assessment that has been conducted by the APVMA and of the specialist advice received from advisory agencies, including other Australian Government agencies and state departments of primary industries. It has been deliberately presented in a manner that is likely to be informative to the widest possible audience to encourage public comment.

About this document

This Public Release Summary indicates that the APVMA is considering an application for registration of an agricultural or veterinary chemical. It provides a summary of the APVMA's assessment, which may include details of:

- the toxicology of both the active constituent and product
- the residues and trade assessment
- occupational exposure aspects
- environmental fate, toxicity, potential exposure and hazard
- efficacy and target crop or animal safety.

Comment is sought from interested stakeholders on the information contained within this document.

Making a submission

In accordance with sections 12 and 13 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether the application for registration of Booster-Mag 609 SC Insecticide should be granted. Submissions should relate only to matters that the APVMA is required, by legislation, to take into account in deciding whether to grant the application. These matters include aspects of public health, occupational health and safety, chemistry and manufacture, residues in food, environmental safety, trade, and efficacy and target crop or animal safety. Submissions should state the grounds on which they are based. Comments received that address issues outside the relevant matters cannot be considered by the APVMA.

Submissions must be received by the APVMA by close of business on 22 February 2022 and be directed to the contact listed below. All submissions to the APVMA will be acknowledged in writing via email or by post.

Relevant comments will be taken into account by the APVMA in deciding whether the product should be registered and in determining appropriate conditions of registration and product labelling.

When making a submission please include:

- contact name
- company or organisation name (if relevant)
- email or postal address (if available)
- the date you made the submission.

Please note: submissions will be published on the APVMA's website, unless you have asked for the submission to remain confidential, or if the APVMA chooses at its discretion not to publish any submissions received (refer to the public consultation coversheet).

Please lodge your submission using the public consultation coversheet, which provides options for how your submission will be published.

Note that all APVMA documents are subject to the access provisions of the *Freedom of Information Act 1982* and may be required to be released under that Act should a request for access be made.

Unless you request for your submission to remain confidential, the APVMA may release your submission to the applicant for comment.

Written submissions should be addressed to:

Case Management and Administration Unit
Australian Pesticides and Veterinary Medicines Authority
GPO Box 3262
Sydney NSW 2001

Phone: +61 2 6770 2300
Email: casemanagement@apvma.gov.au

Further information

Further information can be obtained via the contact details provided above.

Copies of technical evaluation reports covering chemistry, efficacy and safety, toxicology, occupational health and safety aspects, residues in food and environmental aspects are available from the APVMA on request.

Further information on Public Release Summaries can be found on the APVMA website.

Introduction

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of Booster-Mag 609 SC Insecticide. The active constituent, magnesium hydroxide, is currently approved for use as an electrolyte in the registered veterinary product Mega-Lyte Plus (registration number 56424) and is used in human therapeutics but has not previously been approved for use in an agricultural chemical product.

Applicant

Calix Limited.

Purpose of application

Calix Limited has applied to the APVMA for registration of the new product Booster-Mag 609 SC Insecticide, a suspension concentrate formulation (SC) containing 609 g/L of the approved active constituent magnesium hydroxide.

Proposed claims and use pattern

Booster-Mag 609 SC Insecticide is intended for the suppression of two-spotted mite (*Tetranychus urticae*) in tomatoes and cucurbits (field and protected crops). Proposed application methods are by ground boom spray at a rate of 1 to 2 L/ha. The product is to be applied regularly as a preventative/protective spray, at 7 to 14 day intervals, for as long as needed in the crop cycle to suppress mite populations. The recommended spray volume is 200 to 500 L/ha, increasing the water volume as the plant canopy increases.

Mode of action

The mode of action of magnesium hydroxide has not been fully elucidated. The active constituent is not directly toxic to insects or mites. Foliar sprays are likely to have a physical repellent effect through the formation of a coating of magnesium hydroxide on the leaf surface, inducing movement of plant feeding pests away from treated areas.

Overseas registrations

The active magnesium hydroxide is not currently registered overseas for use in an agricultural chemical product.

Chemistry and manufacture

Active constituent

The active constituent magnesium hydroxide is manufactured in Australia. Details of the chemical name, structure, and physicochemical properties of magnesium hydroxide are listed below (tables 1 to 2).

Magnesium hydroxide is an active constituent in the currently registered veterinary product Mega-Lyte Plus (approval number 56424) where it is present as an electrolyte. Magnesium hydroxide is also used in human therapeutics but has not previously been approved for use in an agricultural chemical product.

Magnesium hydroxide is a white powder. It is practically insoluble in water. There are no flammable, explosive, self ignition, and/or oxidizing properties of safety concern for magnesium hydroxide.

Table 1: Nomenclature and structural formula of the active constituent magnesium hydroxide

Common name (ISO):	Magnesium hydroxide
IUPAC name:	Magnesium hydroxide
CAS registry number:	1309-42-8
Molecular formula:	Mg(OH)2
Molecular weight:	58.320 g/mol
Structural formula:	N/A

Table 2: Key physicochemical properties of the active constituent magnesium hydroxide

Physical form:	solid
Colour:	white
Odour:	odourless
Melting point:	>320°C
Boiling point:	>320°C
density:	2.41 g/cm3
Safety properties:	Not considered flammable. Not explosive. No self ignition observed.
Solubility in water:	1.78 mg/L (20°C)
Octanol/water partition coefficient:	Log Kow= 1.65

Formulated product

The product Booster-Mag 609 SC Insecticide will be manufactured in Australia. Tables 3 and 4 outline some key aspects of the formulation and physicochemical properties of the product.

Booster-Mag 609 SC Insecticide will be available in 5 L to 1000 L HDPE (high density polyethylene) containers.

Table 3: Key aspects of the formulation of the product Booster-Mag 609 SC Insecticide

Distinguishing name:	Booster-Mag 609 SC Insecticide
Formulation type:	Suspension concentrate (SC)
Active constituent concentration:	609 g/L

Table 4: Physicochemical properties of the product Booster-Mag 609 SC Insecticide

Physical form:	odourless slightly pink viscous liquid
pH:	10.40 (1% w/w dilution)
Specific gravity/density:	1400 g/L
Kinematic viscosity:	<200 cP
Pourability:	0.18% residue following triple rinsing
Spontaneity of dispersion:	84.6%
Suspensibility:	73.2%
Persistent Foaming:	Does not foam
Safety properties:	Not classified as a flammable liquid, explosive, or an oxidising substance.
Storage stability:	There were sufficient data to conclude that the product is expected to remain within specifications for at least 2 years when stored under normal conditions

Recommendations

The APVMA Chemistry section has evaluated the chemistry of the active constituent magnesium hydroxide and associated product Booster-Mag 609 SC Insecticide, including the manufacturing process, quality control procedures, stability, batch analysis results, and analytical methods, and found them to be acceptable. The available storage stability data indicate that the formulated product is expected to remain stable for at least 2 years when stored under normal conditions.

Based on a review of the chemistry and manufacturing details, the registration of Booster-Mag 609 SC Insecticide, and approval of the active constituent magnesium hydroxide, are supported from a chemistry perspective.

Toxicological assessment

The following information on magnesium hydroxide was derived from the ECHA REACH database, together with other published sources of information.[1]

Evaluation of toxicology

Chemical class

Magnesium hydroxide is an inorganic compound currently approved for use in the registered veterinary product Mega-Lyte Plus (registration number 56424) as an electrolyte. It is also used in human therapeutics. It has not been previously approved for use in Australia as an agricultural chemical for the control of insect pests.

Pharmacokinetics

Magnesium hydroxide is used extensively in human medicine as an antacid to neutralise stomach acid and to assist in the treatment of indigestion and heartburn. It is also used as a laxative; an antiperspirant deodorant; and for the topical treatment of canker sores. Magnesium is absorbed predominantly in the distal intestine, widely distributed throughout the body, and rapidly excreted in the urine.

Acute toxicity (active constituent)

Magnesium hydroxide has low acute oral and dermal toxicity, is non irritant or corrosive to skin, and is not an eye irritant.

Acute toxicity (product)

The formulated product, Booster-Mag 609 SC Insecticide containing 609 g/L of magnesium hydroxide, has low acute oral, dermal, and inhalational toxicity; is non irritating to eyes and skin; and is not a skin sensitiser.

Repeat-dose toxicity

In short- and long-term repeat oral dosing studies, no treatment related adverse effects were observed in rats or mice at the highest dose tested. Magnesium hydroxide was not genotoxic in a series of in vitro and in vivo tests or carcinogenic in mouse or rat bioassays. Magnesium hydroxide was not immunotoxic nor a reproductive toxicant. Based on the results of acute and short-term studies in rats, it was concluded that magnesium hydroxide is unlikely to be a neurotoxin.

[1] Available here: https://echa.europa.eu/cs/registration-dossier/-/registered-dossier/16073/7/1

Health based guidance values and poisons scheduling

Poisons Standard

On 22 April 2021, the Delegate to the Secretary of the Department of Health published a final scheduling decision to list a new entry for magnesium hydroxide in Appendix B (substances considered not requiring control by scheduling) and confirmed an implementation date of 1 June 2021.2 The reason for the Delegate's decision to list magnesium hydroxide in Appendix B was its low toxicity. None of the product excipients/impurities are scheduled; therefore, Booster-Mag 609 SC Insecticide will not require a signal header on the label.

Health based guidance values

Acceptable daily intake

The acceptable daily intake (ADI) is that quantity of a chemical compound that can safely be consumed on a daily basis for a lifetime. Due its low oral toxicity, an ADI was considered unnecessary for magnesium hydroxide.

Acute reference dose

The acute reference dose (ARfD) is the maximum quantity of a chemical that can safely be consumed over a short period of time, usually in one meal or during one day. Due to its low oral toxicity and the absence of any neurological effects or developmental toxicity after a single dose, an ARfD was considered unnecessary for magnesium hydroxide.

Recommendations

There are no objections on human health grounds to the approval of magnesium hydroxide as an active constituent for agricultural use.

[2] See final decision published to TGA website and available for download here: https://www.tga.gov.au/sites/default/files/notice-final-decisions-acms-32-accs-29-joint-acms-accs-26-november-2020-meetings.pdf

Residues assessment

Metabolism

A Table 5 entry is proposed for magnesium hydroxide as magnesium is ubiquitous in the environment. As MRLs are not necessary for magnesium hydroxide, it is not necessary to establish a residue definition.

Analytical methods and storage stability

Soil and plant samples were analysed for magnesium content in a study on grapevines provided in support of the application. Samples were analysed by AgVita analytical and the analytical reports were provided in the study.

Crop residues and MRLs

Magnesium is an essential dietary nutrient and is present in many foods. Magnesium is also used in foliar fertilisers and in fertilisers applied to magnesium deficient soils.

A study on grapevines was provided in support of the application. This study included a comparison of magnesium levels in berries, leaf petioles, and soil from treated samples versus untreated (control) samples. Treatments of Booster-Mag-C 609 SC were applied alone, at 4 rates (including the proposed label rates of 1 and 2 L/ha), as 7 dilute foliar sprays just prior to the point of run off in spray volumes from 690 to 900 L/ha, beginning at the 10% and 80% capfall and pre bunch closure (Timings A-C), followed by 4 sprays at 9 to 19 day intervals from veraison to harvest (Timings D-G).

At 19 days after application G (DAAG) when berries were ripe for harvest, magnesium levels in grape berries (washed and unwashed) and leaf petioles sprayed with Booster-Mag-C at 1 to 2 L/ha were comparable with the untreated control. These results demonstrate that in treated grapes, the use of Booster-Mag 609 SC Insecticide does not increase the concentration of magnesium in the fruit.

At 20 DAAG, magnesium levels in soil collected under grapevines sprayed with Booster-Mag-C at 1 or 2 L/ha were comparable with the untreated control.

Given that magnesium is an essential nutrient and that any residues are indistinguishable from naturally occurring sources and should not be of toxicological significance – noting that an ADI has not been established for magnesium hydroxide – the proposed use of magnesium hydroxide on tomatoes and cucumbers is suitable for an entry in Table 5 of the APVMA MRL Standard. Table 5 lists uses of substances where MRLs are not necessary. MRLs are not necessary in situations where residues do not, or should not, occur in foods or animal feeds; where the residues are identical to, or indistinguishable from, natural food components; or otherwise are of no toxicological significance.

Animal commodities and MRLs

Tomato pomace is used as a feed for livestock in Australia. However, any residues of magnesium ions will be indistinguishable from those that are naturally occurring and a Table 5 entry has been proposed. It is not necessary to establish animal commodity MRLs.

Dietary exposure

Magnesium is an essential nutrient and a Table 5 entry has been recommended to cover the proposed use. Any residues of magnesium ions will be indistinguishable from those that are naturally occurring. It is not necessary to conduct a dietary risk assessment, noting also that an ADI and ARfD were considered unnecessary for magnesium hydroxide by the APVMA Health Assessment Team.

Trade

The proposed use does not involve treatment of major trade commodities and significant residues are not expected to arise in livestock feeds as a result of the proposed use. Any residues of magnesium ions will be indistinguishable from those that are naturally occurring. The risk to trade is low.

Recommendations

The following amendments are required to be made to the APVMA MRL Standard (Table 5).

Table 5: Amendments to the APVMA MRL Standard

Amendments to Table 5	
Substance	**Use**
ADD:	
Magnesium hydroxide	As an insecticide on tomatoes and cucurbits

Assessment of overseas trade aspects of residues in food

Potential risk to trade

The proposed use does not involve treatment of major trade commodities and significant residues are not expected to arise in livestock feeds as a result of the proposed use. Any residues of magnesium ions will be indistinguishable from those that are naturally occurring. The risk to trade is low.

Work health and safety assessment

Health hazards

The formulated product, Booster-Mag 609 SC Insecticide, containing 609 g/L of magnesium hydroxide, has low acute oral, dermal, and inhalational toxicity; is non irritating to eyes and skin; and is not a skin sensitiser.

Occupational exposure

Exposure during use

The product is intended for professional use only and will be applied mechanically by ground boom. According to the draft label, the product is to be applied at a rate of 2 L/ha (1.218 kg a.c./ha) in a minimum water volume of 200 L/ha. The maximum concentration of the product in the spray is 609 g/L (1.0% v/v). The applicant stated that up to 1200 L of product may be used per day, sufficient to treat 600 ha. The product is to be applied soon after crop emergence at 7 to 14 day intervals and may be applied throughout the crop growing season (2 to 3 months), depending on insect pressure. Therefore, the pattern of exposure is expected to be of intermediate term duration. Assessment of occupational risks during mixing, loading, and application were considered to be acceptable for workers wearing overalls and gloves.

Exposure during re-entry or rehandling

Based on the low acute oral, dermal, and inhalational toxicity of magnesium hydroxide, no re-entry statement or re-handling assessment is required.

Public exposure

No direct exposure to the general population is anticipated from product use. No exposure of the public to spray drift from ground boom spraying is anticipated and no spray drift buffer zones for bystanders are required.

Exposure to magnesium hydroxide residues is possible from the ingestion of residues in crops treated with Booster-Mag 609 SC Insecticide. However, as determined in the APVMA Residues assessment, any residues of magnesium ions will be indistinguishable from those that are naturally occurring in plants as an essential nutrient. No ADI has been established for magnesium hydroxide due to its low toxicity and high oral NOAEL values seen in chronic animal studies.

Recommendations

There are no objections on human health or worker safety grounds to the registration of the product Booster-Mag 609 SC Insecticide, containing 609 g/L of magnesium hydroxide, when used according to the label instructions.

The following first aid instructions, safety directions, and precautionary (warning) statements are recommended for the product label.

First aid instructions

First aid is not generally required. If in doubt, contact a Poisons Information Centre (phone Australia 13 11 26; New Zealand 0800 764 766) or a doctor.

Safety directions

When opening the container, preparing the spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow length PVC gloves. When using the prepared spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing). Wash hands after use. After each day's use, wash gloves and contaminated clothing.

Precautionary (warning) statements

Not required.

Restraints

For PROFESSIONAL use only

DO NOT allow bystanders to come into contact with the spray cloud.

Re-entry statement

Not required.

Environmental assessment

Fate and behaviour in the environment

Magnesium is an essential element for plant growth and development and plays a key role in plant defence mechanisms. It is a common constituent in many minerals, comprising 2% of Earth's crust; however, most soil magnesium (90 to 98%) is incorporated in the crystal lattice structure of minerals and thus not directly available for plant uptake. Plants absorb magnesium from the soil solution, which is slowly replenished by soil reserves.

Magnesium hydroxide is an inorganic compound. It is naturally found as the mineral brucite. It is commercially used as a fire retardant and to neutralize acidic wastewaters. Magnesium is very mobile in soils because it is less bound to the soil charges. Studies indicate that there is almost no magnesium leaching risk from slow release Mg fertilisers like dolomite or fertilisers containing Mg in the form of magnesium oxide, including magnesium hydroxide. Solubility of magnesium hydroxide is low (1.78 mg/L), and it is not completely insoluble. It could be concluded that magnesium hydroxide may have a greater adsorption in soil and thus have a lower leaching potential. Based on the physicochemical properties, breakdown pathway, and the low likelihood of exposure, it is proposed that magnesium hydroxide does not pose a risk to soil.

Submitted field studies investigating residues following applications of Booster-Mag 609 SC Insecticide to grapevines at rates up to 12.6 kg a.c./ha indicated magnesium levels of in soil, berries or leaf petioles were not elevated relative to untreated controls. This indicates that magnesium concentrations following a maximum seasonal rate of 11.2 kg a.c./ha would be comparable to natural background concentrations.

Effects and associated risks to non target species

Submitted data indicated that the formulated product has low toxicity to mammals (LD50>1009 mg a.c./kg bw, *Rattus norvegicus*), and low toxicity to adult bees following contact exposure (LD50>100 µg a.c./bee, *Apis mellifera*) and oral exposure (LD50 486 µg ac/bee, *Apis mellifera*). No phytotoxicity of grapevines was evident in crop safety trials at rates up to 12.6 kg a.c./ha.

Based on submitted field studies, magnesium concentrations in soil and foliage under the proposed conditions of use are expected to be comparable to natural background concentrations. Therefore, risks to non target species are considered to be acceptable without further assessment. No protection statements are required.

Recommendations

Based on assessment of environmental data, it was determined that the use of Booster-Mag 609 SC Insecticide, when used according to instruction, would not be likely to have an unintended effect that is harmful to animals, plants, things, or to the environment.

The following mitigation/labelling statements are recommended based on the outcome of the risk assessment and current label standards. Please note the environmental assessment does not consider storage conditions of the product.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT

DO NOT contaminate wetlands or watercourses with this product or used containers.

DISPOSAL

Triple-rinse containers before disposal. Add rinsings to spray tank. Do not dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and deliver empty packaging to an approved waste management facility. If an approved waste management facility is not available, bury the empty packaging 500 mm below the surface in a disposal pit specifically marked and set up for this purpose, clear of waterways, desirable vegetation and tree roots, in compliance with relevant local, state or territory government regulations. Do not burn empty containers or product.

Efficacy and safety assessment

Proposed product use pattern

Booster-Mag 609 SC Insecticide is a suspension concentration (SC), containing 609 g/L magnesium hydroxide. Proposed label uses are for the suppression of two-spotted mite (*Tetranychus urticae*) populations on tomatoes and cucurbits (protected and field grown). Proposed application methods are by mechanical boom sprayer at a rate of 1 to 2 L/ha with a recommended spray volume of 200 to 500 L/ha, increasing the water volume as the plant canopy increases. Booster-Mag 609 SC Insecticide is to be applied regularly, at an interval of 7 to 14 days, early in the crop cycle before pest populations become established, to prevent economic injury levels from being reached and thus reduce the number of conventional insecticide interventions required over a season, without compromising crop yield or yield quality.

The mode of action of Booster-Mag 609 SC Insecticide is not fully understood. The active constituent, magnesium hydroxide, is not directly toxic to insects or mites. Foliar sprays are likely to have a physical repellent effect through the formation of a coating of magnesium hydroxide on the leaf surface, inducing plant feeding pests to move away from treated areas.

Efficacy and target crop safety

Data from 12 laboratory, glasshouse, and field trials, together with scientific argument, were submitted to support the label claims of product efficacy and crop safety for Booster-Mag 609 SC Insecticide. All trials were appropriately designed and analysed statistically. Field trials were conducted mainly in commercial crops in Victoria and Queensland, in environments typical of where Booster-Mag 609 SC Insecticide would be used.

Initial laboratory and glasshouse studies were conducted at the University of NSW in 2015 to determine the impact of Booster-Mag 609 SC Insecticide on two-spotted mites infesting native violets (*Viola banksia*). Booster-Mag 609 SC Insecticide was sprayed by hand onto mite infested plants as a 2 or 5% solution (w/w) and compared to plants treated with a broad spectrum insecticide (pyrethrum), applied at the label rate, and an untreated control.

Field trials were conducted in northern Victoria over 2 seasons to evaluate the potential of Booster-Mag 609 SC Insecticide in the management of tomato pests. These trials were designed to assess efficacy under actual commercial use conditions. In 2015–16, a split plot, multi replicate field trial was undertaken across 3 commercial processing tomato farms. Within each farm, 3 sprays of Booster-Mag 609 SC Insecticide were applied over a period of 33 days, at a rate of 1.5 L/ha, in addition to conventional pesticide treatments applied throughout the season according to standard integrated pest management (IPM) practices and agronomist advice. Larger scale field trials were conducted in 2016–17 with the aim to further quantify differences in farm productivity that Booster-Mag 609 SC Insecticide may provide, in terms of yield and yield quality, as well as agronomic management and input costs. On 2 farms, yields and production costs were compared in tomatoes managed using conventional pesticides with those managed using Booster-Mag 609 SC Insecticide and a reduced number of pesticide treatments (only applied if pest thresholds were exceeded). Booster-Mag 609 SC Insecticide was applied 6 (Farm 1) or 4 (Farm 2) times, every 10 to 14 days, at a rate of 1.4 kg a.c./ha, using a standard boom sprayer and nozzles, as a strategic base treatment

commencing approximately 14 days from transplant. If pest or pathogen pressure reached pre determined thresholds, the grower reverted to the use of conventional crop protection chemicals. The overall IPM methodology applied, including threshold values, was consistent with that developed by the Australian Processing Tomato Research Council (APTRC) in conjunction with Agriculture Victoria. An untreated control was not included in this trial as Booster-Mag 609 SC Insecticide treated tomatoes were compared directly with those under conventional agronomic management on commercially operated farms. On the 2 farms, a 7.8 and 4.9 ha area of tomatoes under conventional agronomic management was compared with an adjacent area of 5.5 and 4.4 ha under management with Booster-Mag 609 SC Insecticide and reduced pesticide management, respectively.

8 replicated field trials were conducted in Victoria and Queensland, between 2016 and 2021, to determine the efficacy and crop safety of Booster-Mag 609 SC Insecticide when applied to commercial tomato and cucurbit crops (zucchini, eggplant, watermelon) and an ornamental crop (roses). In all trials, efficacy and safety of several consecutive applications of Booster-Mag 609 SC Insecticide, applied at various rates by a hand held boom spray at 7 to 14 day intervals, was compared to a grower spray programme using industry standard insecticides/miticides (containing sulphur, pest oil, or abamectin) and to an untreated control. In some trials, the effect of adding a wetting agent or surfactant to Booster-Mag 609 SC Insecticide was also investigated. All treatments were replicated in a randomised, complete block design and the results were analysed using appropriate statistical methods. Phytotoxicity was assessed using standard visual assessment methods. Efficacy of Booster-Mag 609 SC Insecticide to suppress tomato thrips (*Frankliniella schultzei*), melon thrips (*Thrips palmi*), *Helicoverpa* spp., silverleaf whitefly (*Bemisia tabaci*), green peach aphid (*Myzus persicae*), melon aphid (*Aphis gossypii*), two-spotted mites (*Tetranychus urticae*), and/or various diseases was assessed whenever these pests were present in crops by counting numbers on randomly sampled leaves and/or flowers. Phytotoxicity and efficacy assessments were made at various times throughout the crop stages of growth. Crop yield assessments were also made in most trials.

Efficacy

Laboratory and glasshouse trials demonstrated the efficacy of Booster-Mag 609 SC Insecticide to suppress two-spotted mites infesting native violets. After 48 hours, significantly lower numbers of mites were found on Booster-Mag 609 SC Insecticide treated plants when compared to the untreated control. The level of mite population reduction achieved by Booster-Mag 609 SC Insecticide was statistically equivalent to plants treated with pyrethrum. A further glasshouse experiment suggested that Booster-Mag 609 SC Insecticide acts as a repellent, inducing adult mites to move away from treated plants but with no apparent direct effect on mortality.

Field trials conducted in 2015–16 found that application of Booster-Mag 609 SC Insecticide increased the average yield of red and unblemished fruit across all 3 farms by 6% relative to the conventionally farmed controls, an outcome concomitant with observed reductions in unripe, blossom end rot and insect affected fruit. In the larger scale field trials conducted in 2016–17, a 50% reduction in conventional insecticide treatments was achieved when Booster-Mag 609 SC Insecticide was used, with no significant effect on crop yield or quality. This contributed to an estimated reduction in agronomic management costs of 38 to 50%. The presence and activity of beneficial insects was also noted to be higher in the Booster-Mag 609 SC Insecticide treated plants than those under conventional management.

Sufficient populations of two-spotted mites developed in 4 of the 8 replicated field trials to enable the assessment of the efficacy of Booster-Mag 609 SC Insecticide to suppress this species infesting field grown tomatoes, cucurbits and roses. Booster-Mag 609 SC Insecticide applied at 1 L/ha or higher, with or without a wetting agent, suppressed populations of two-spotted mite eggs, nymphs and adults, at statistically equivalent rates to the industry standard miticides tested. Levels of mite population reduction achieved by Booster-Mag 609 SC Insecticide varied according to pest pressure, timing of sprays, and application rates, but generally ranged between 40 to 50% of the control population. In some trials, low pest pressure and considerable variation in mite numbers between replicates affected the statistical significance of the level of suppression.

Densities of other pests present in the trials were too low or variable for reliable efficacy assessments to be made. While application of Booster-Mag 609 SC Insecticide did, on occasion, result in significant levels of suppression of thrips, Helicoverpa, aphid, and whitefly populations, when compared to the untreated controls, the results were not consistent over time and/or between trials. Generally, Booster-Mag 609 SC Insecticide treatments suppressed insect populations at statistically equivalent levels to a grower spray programme using industry standard insecticides/miticides.

Overall, it is considered that there are sufficient laboratory and field trial data to support a label claim for the suppression of two-spotted mite populations in tomato and cucurbit crops, when used as directed. Grower field trials provided further evidence that the early and regular application of Booster-Mag 609 SC Insecticide, at the proposed label rates, can reduce the number of conventional insecticide/miticide sprays required to control insect and mite pests over the season, without compromising crop yield or yield quality. Further trial data are required to extend the label claim to include other insect pests of tomatoes and cucurbits.

Crop safety

No phytotoxicity was observed in any crop or trial when up to 9 consecutive sprays of Booster-Mag 609 SC Insecticide were applied at up to twice the maximum label rate (4 L/ha). The addition of a wetting agent or surfactant to Booster-Mag 609 SC Insecticide did not cause any phytotoxicity issues. The data are supportive of crop safety in tomatoes and cucurbits.

Resistance management

The mode of action of magnesium hydroxide has not been fully elucidated but it is thought to affect the behaviour of plant feeding pests, inducing movement away from treated areas, with no apparent direct toxic effect. Behaviour modifying agents are not included in the Insecticide Resistance Action Committee Mode of Action Classification Scheme (IRAC 2020).[3] Given that Booster-Mag 609 SC Insecticide does not have a direct toxic effect on pests, the risk of resistance developing is considered to be very low. As directed on the label, use of Booster-Mag 609 SC Insecticide can be alternated with conventional insecticides/miticides with different modes of action if pest pressure thresholds are reached.

[3] More details on the IRAC classification scheme are available here: https://irac-online.org/mode-of-action/

Recommendations

Trial data demonstrated that Booster-Mag 609 SC Insecticide will be effective in suppressing mite infestations in tomatoes and cucurbits when used as directed at the proposed label rate of 1 to 2 L/ha. Multiple applications of the product, applied at 7 to 14 day intervals, are required and were safe on all crops tested, even when applied at up to twice the label rate.

There are no objections on efficacy or target crop safety grounds to the registration of the product Booster-Mag 609 SC Insecticide, containing 609 g/L magnesium, for the suppression of two-spotted mites in tomatoes and cucurbits.

Spray drift assessment

No spray drift buffer zones are required for Booster-Mag 609 SC Insecticide.

Labelling requirements

READ SAFETY DIRECTIONS BEFORE OPENING OR USING

BOOSTER-MAG 609 SC INSECTICIDE

ACTIVE CONSTITUENT: 609 g/L MAGNESIUM HYDROXIDE

For the suppression of two-spotted mites on tomatoes and cucurbits

CONTENTS: 5 L – 1000 L

Calix Ltd ABN 117 372 540
Level 1, 9 Bridge Street, Pymble, NSW, 2073, Australia

APVMA Approval No.:

DIRECTIONS FOR USE

RESTRAINTS
For PROFESSIONAL use only
DO NOT allow bystanders to come into contact with the spray cloud

CROP	PEST	RATE	CRITICAL COMMENTS
Tomatoes (Protected and field) **Cucurbits** (Protected and field)	Two-spotted mites (suppression)	1-2 L/ha	Best used as part of a preventative spray programme. Begin application soon after emergence or transplant. BOOSTER-Mag applications should begin prior to two-spotted mites being present. Apply at 7-14 day intervals, increasing frequency when conditions are conducive to mite proliferation and new foliage growth is vigorous. Apply as long as needed throughout the crop cycle. Crop monitoring is essential to ensure insect pests levels do not reach economic thresholds; if pressure continues to build, consider intervention with an alternative registered miticide. Thorough coverage of both sides of the leaves must be ensured at all times. Recommended spray volume: 200L – 500 L/ha. Increase water volume as plant canopy increases. For best results it is recommended BOOSTER-Mag be applied with a non-ionic surfactant particularly when applying 1 L/ha.

NOT TO BE USED FOR ANY PURPOSE, OR IN ANY MANNER, CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

WITHHOLDING PERIOD
Nil

GENERAL INSTRUCTIONS
Used according to instructions, BOOSTER-Mag will suppress pest activity and reduce crop damage.
Best results are achieved when used as part of a preventative treatment programme with application commencing at first sign of pests/before pest pressure is apparent.
BOOSTER-Mag is compatible with Integrated Pest Management programmes.
Apply for non-lethal insect pest suppression.
May be applied regularly throughout the crop cycle and its use can be alternated with insecticides with alternative modes of action if pest pressure thresholds are reached.
BOOSTER-Mag will generally enable pest-toxic insecticide use to be reduced.
Effective crop monitoring is recommended.

MIXING DIRECTIONS
Half fill tank with water. Add the required amount of BOOSTER-Mag concentrate while agitating. Add remainder of the water and continue agitation until completion of spraying.

Do not leave spray mixture overnight.

Ensure that the spray tank and hoses are properly cleaned inside after applying BOOSTER-Mag.

APPLICATION
Apply with calibrated ground spraying equipment, with recommended water volumes of 200 – 500 L/ha.

PROTECTION OF WILDLIFE, FISH, CRUSTACEANS AND ENVIRONMENT
DO NOT contaminate wetlands or watercourses with this product or used containers.

STORAGE AND DISPOSAL
Store in the closed, original container in a cool, well-ventilated area. DO NOT store for prolonged periods in direct sunlight.

HDPE packaging may be recycled as non-hazardous waste. Triple rinse containers before disposal. Add rinsings to spray tank. DO NOT dispose of undiluted chemicals on site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush or puncture and deliver empty packaging to an approved waste management facility. If an approved waste management facility is not available, bury the empty packaging 500 mm below the surface in a disposal pit specifically marked and set up for this purpose, clear of waterways, desirable vegetation and tree roots, in compliance with relevant local, state or territory government regulations. Do not burn empty containers or product.

Re-fillable Containers
Empty contents fully into application equipment. Close all valves and return to point of sale or as advised by supplier for refill or storage.

SAFETY DIRECTIONS
When opening the container, preparing the spray, wear cotton overalls buttoned to the neck and wrist (or equivalent clothing) and elbow length PVC gloves. When using the prepared spray, wear cotton overalls buttoned

to the neck and wrist (or equivalent clothing). Wash hands after use. After each day's use, wash gloves and contaminated clothing.

FIRST AID INSTRUCTIONS

First Aid is not generally required. If in doubt, contact a Poisons Information Centre (e.g. phone Australia 13 11 26, New Zealand 0800 764 766) or a doctor.

Acronyms and abbreviations

Shortened term	Full term
a.c.	active constituent
ADI	acceptable daily intake (for humans)
a.i.	active ingredient
ARfD	acute reference dose
bw	bodyweight
d	day(s)
DAT	days after treatment
g	gram
h	hour
ha	hectare
IPM	integrated pest management
in vitro	outside the living body and in an artificial environment
in vivo	inside the living body of a plant or animal
kg	kilogram
L	litre
LD_{50}	dosage of chemical that kills 50% of the test population of organisms
Log K_{OW}	log to base 10 of octanol water partitioning co-efficient, synonym P_{OW}
µg	microgram
mg	milligram
mL	millilitre
MRL	maximum residue limit
ng	nanogram
NOAEL	no observed adverse effect level
pH	potential of hydrogen
s	second
SC	suspension concentrate

Shortened term	Full term
v/v	volume by volume
WHP	withholding period
w/w	weight to weight

Glossary

Term	Description
Active constituent	The substance that is primarily responsible for the effect produced by a chemical product
Acute	Having rapid onset and of short duration
Carcinogenicity	The ability to cause cancer
CAS number	Unique numerical identifier assigned by the Chemical Abstracts Service (CAS) to every chemical substance
Chronic	Of long duration
Codex MRL	Internationally published standard maximum residue limit
Desorption	Removal of a material from or through a surface
Efficacy	Production of the desired effect
Formulation	A combination of both active and inactive constituents to form the end use product
Genotoxicity	The ability to damage genetic material
Hydrophobic	Repels water
Immunotoxic	Adverse effect on the structure or function of the immune system, or on other systems as a result of immune system dysfunction
IUPAC name	International Union of Pure and Applied Chemistry naming scheme for organic compounds
Leaching	Removal of a compound by use of a solvent
Metabolism	The chemical processes that maintain living organisms
Pharmacokinetics	The study of the movement of substances within the body
Photodegradation	Breakdown of chemicals due to the action of light
Photolysis	Breakdown of chemicals due to the action of light
Toxicokinetics	The study of the movement of toxins through the body
Toxicology	The study of the nature and effects of poisons

References

IRAC 2021, IRAC mode of action classification scheme, issued September 2021, v. 10.1, Insecticide Resistance Action Committee, available at: irac-online.org/modes-of-action/