

Developing New Insecticides Derived From Nature to Achieve High Impact – Globally



Tim Grogan Managing Director & CEO



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ASX:BGT www.bio-gene.com.au

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Bio-Gene is Developing New Insecticides Derived From Nature to Achieve High Impact - Globally

Two New Actives	 Bio-Gene is developing two botanically derived active ingredients with novel insecticidal modes of action: Flavocide® and Qcide® are derived from a specific type of eucalypt Are effective in protecting against insects with resistance to current products Strong consumer and environmental drivers are increasing the demand for safer and more environmentally friendly products New category of opportunity - recent synergy data 	CANADA UNITED STATES
Large Target Markets	Crop Protection (incl. Grain Storage), Public Health , Consumer , Animal Health , total addressable markets of \$31B	
Focused Pipeline	 Pipeline defined based on a competitive assessment process Public Health – vectors for disease Grain Storage Protection Consumer plus proof of concept opportunities plus the recent STK (Qcide) deal opens up the Crop Protection, Aquaculture, Professional Turf and Ornamentals markets 	AUSTRALIA BUSTRALIA
Strong Partnering Progress	Three partnerships to date : Clarke Mosquito (US), Evergreen (EU, UK, AU & NZ), STK (Israel)	× /*

TECHNOLOGY

Flavocide[®] & Qcide[®] 101 Novel insecticides derived from nature.

QCIDE – a botanical insecticide with a new mode of action

Qcide is an 100% natural oil extracted from the leaves of a specific cultivar of eucalypt (Gypmie messmate), containing high levels (>80%) of tasmanone. The trees are currently farmed in northern Australia.

FLAVOCIDE – a nature identical compound with a new mode of action for use as an insecticide

Flavocide is based on flavesone, a naturally occurring plant compound that is synthesised via a proprietary process that allows production in large volumes for global demand, to a purity of >96%.

Tasmanone & flavesone are beta-triketone compounds with insecticidal activity primarily acting as contact insecticides.

Qcide and Flavocide assist to meet the world's demand for more sustainable agriculture and solutions derived from nature to feed the growing world population.



Gympie messmate frown from tissue culture and in the field in northern Australia.

The novel modes of action of Flavocide and Qcide provide a new option to prevent the development of insects resistant to the current range of insecticides.

Patent families owned by Bio-Gene include:

- ✓ Control of resistant pests
- ✓ Use in synergistic combinations
- ✓ Control of specific pests e.g., aphids
- ✓ Ovicidal activity against insect pests e.g., mites, bed bugs

BIO-GENE

- ✓ Area coverage includes:
- ✓ Australia & New Zealand
- ✓ USA/Europe
- ✓ Latin America (Brazil)
- ✓ Asia (China)
- ✓ Africa (RSA)



Bio-Gene's Product Pipeline Eight programs across Crop Protection, Public Health & Consumer Sectors.

	Flavocide [®] (Active constituent)					Pre-registration	BIO-GENE	
	Description	Code	Sector	Target Market	Target Species	Use	Stage	Partner
Formulated products	Grain Protectant	F8	Crop protection	Admixture to grain (in combination for IPM)	Lesser grain borer Rice weevil, Flour beetle Saw-toothed grain beetle Rusty red grain beetle	Professional use	Formulation development	GRDC GRAINS RESEARCH & DEVELOPMENT COPPORATION
	Outdoor Space Spray	F11	Public health	Flying insects	Mosquitos	Professional use	Formulation development	(USA & Cayman Is.)
	Indoor Barrier Spray	F28	Public health	Flying & crawling insects (residual)	Mosquitos, ants, cockroaches	Professional use (kill & repel)	Formulation development	-
	Outdoor Barrier Spray	F13	Public health	Flying & crawling insects (residual)	Mosquitos, ants, cockroaches	Professional use (kill & repel)	Formulation development	(USA & Cayman Is.)
	Indoor Space Spray	F12	Consumer	Flying & crawling insects	Mosquitos, house flies, ants	Personal use	Formulation development	UK, EU, AU & NZ
	Qcide® (Active constituent) Pre-registration							
Formulated products	Indoor Space Spray	Q18	Consumer	Flying insects	Mosquitos & house flies	Personal use	Formulation development	-
	Outdoor Barrier Spray	Q13	Consumer	Flying insects	Mosquitos & house flies	Personal use	Formulation development	-
	Outdoor Garden Spray	Q20	Consumer	Fruit & vegetables, ornamentals	Sucking pests: mites, aphids, orange stink bug, scale	Personal use	Formulation development	EVERGREEN Garden Care AU & NZ



Flavocide® Active Constituent Development Path Regulatory approval of a formulated product is a two-step process.



Recent Significant Advancements

Synergy Data (26 April 2023)

SYNERGY STUDIES WITH FLAVOCIDE[™] AND QCIDE[™] OFFER SIGNIFICANT NEW COMMERCIAL OPPORTUNITIES FOR USE WITH OTHER INSECTICIDES

- Research program demonstrates positive synergistic ability for both Bio-Gene molecules, Flavocide[™] and Qcide[™], when used in combination with other commercially important insecticides
- Positive synergy results significantly expand the possible commercial opportunities for Bio-Gene in the US\$31.1 billion global insecticide market¹ by providing industry benefits including:
 - lower dosage requirements leading to reduced cost application and improved environmental safety
 - extended use of commercial partner post-patent products with added benefit of increased efficacy against resistant pests
- Early stage results have already drawn interest from global companies with the recent signing of a Material Transfer Agreement
- Program studies conducted by globally recognised research organisations: Purdue University; University
 of Florida; i2L Research; and cesar Australia
- Tests demonstrate synergy with particular commercially important molecules from other chemical groups against certain target insect species, including resistant strains
- Reinforces value of Bio-Gene products' unique Mode of Action to provide more effective control and address resistance of pests to several insecticides

Flavocide Manufacture (30 October 2023)

Signed agreement with a large manufacturer in India for FLAVOCIDE[®] synthesis.

In September 2023, Bio-Gene signed an agreement with a large contract manufacturer in India for the custom scale-up synthesis of FLAVOCIDE^{*}. This follows a detailed review of the capabilities of several companies internationally and resulted in the identification of Bio-Gene's preferred partner. Bio-Gene has now engaged with this company to validate and optimise the process developed by Bio-Gene and scale-up this process to produce pilot scale batches. This is a significant step towards Bio-Gene's ability to support both the registration enabling studies as well as meet market demand for FLAVOCIDE^{*} once registered. This company has the potential to be appointed in the future as a toll manufacturer of FLAVOCIDE^{*} for commercial use.

(27 July 2023) STK (Qcide)

BIO-GENE EXECUTES DEVELOPMENT AND LICENSE AGREEMENT WITH STK

- Bio-Gene signs a Development and License Agreement with STK Bio-Ag Technologies (STK) formalising the existing binding term sheet
- The terms of the Development and License Agreement are in line with the existing binding term sheet
- Bio-Gene grants STK a world-wide non-exclusive license to develop Qcide[®] technology for crop protection applications, as well as aquaculture, professional turf and ornamentals markets
- STK funds all costs associated with securing the active ingredient registrations for Qcide
- Bio-Gene retains exclusive rights to the public health, animal health and consumer markets for Qcide globally, whilst retaining non-exclusive rights for the STK field of use markets
- Bio-Gene gains full access to Qcide registrations to support other commercial opportunities in all crop and non-crop applications

(24 July 2023) CDC Vector Control (Ticks)

BIO-GENE TECHNOLOGY SELECTED TO PARTICIPATE IN US CENTER FOR DISEASE CONTROL (CDC) FUNDED VECTOR CONTROL PROGRAM

- Bio-Gene's technology, Flavocide[®] and Qcide[®], to be included in a Center for Disease Control (CDC) funded vector control program
- Program is coordinated by the Midwest Center of Excellence for Vector Borne Disease (MCE-VBD)
- Studies involving Bio-Gene's technology will be conducted by Purdue University, who have significant history and knowledge of Bio-Gene's products
- Program focuses on ticks as major vectors of disease
- Bio-Gene will have access to the results for discussion with researchers and potential commercial collaborators



The Mosquito is *"the World's Deadliest Animal"*¹ Responsible for more human deaths than any other creature on earth.

- Mosquitos approximately 3,600 species of small flies comprising the family *Culicidae*
- Life cycle consists of egg, larva, pupa, and adult stages
- Adult females have tube-like mouthparts to pierce the skin of a host and feed on blood for protein and iron needed to produce eggs
- Vector species prefer: those with type O blood, heavy breathers (CO₂), an abundance of skin bacteria, high body heat, and pregnant women, with some heritable, genetically-controlled component
- Via their saliva, mosquitoes are important vectors of viruses and other diseases:

Mosquitos - Vectors of disease ² :		
Aedes aegypti	Anopheles	Various species
Viral diseases: yellow fever, dengue fever, Zika and chikungunya	Parasitic diseases (malaria) caused by various species of Plasmodium and filariasis	Viral encephalitis viruses, West Nile virus, Heartworm Disease, Zika

1. US Centers for Disease Control and Prevention. 3. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change, SJ. Ryan et. al. 2. World Malaria Report 2022 (WHO). 4. NEA | NEA Launches National Dengue Prevention Campaign Early To Urge Continued Vigilance And Avert A Dengue Outbreak In 2023





247 million malaria cases in 2021 (increasing) in 84 malaria endemic countries.**

Between 2019 and 2020 malaria deaths increased by 10% to 625,000.

Approx. 5% of all human deaths in history have been caused by mosquito-borne diseases.

Over 32,000 cases of Dengue were recorded in Singapore in 2022.⁴





Current Insecticidal Treatments (Flying pests & vector control)

Synthetic insecticides (organophosphorus, carbamate, synthetic pyrethroid, nicotinic & diamide)

1. Outdoor Space & Barrier sprays:

- Deltamethrin
- Permethrin
- Lambda-cyhalothrin
- Alpha-cypermethrin
- Gamma-cyhalothrin
- Clothianidin (neonicotinoid)

2. Outdoor/Indoor Space Sprays:

- Deltamethrin
- Pyrethrins
- Sumithrin
- Prallethrin
- Cyphenothrin
- Trans-cyphenothrin
- d-Phenothrin
- Esfenvalerate
- Various mixtures of the above SPs
- Malathion (organophosphate)
- Chlorpyrifos (organophosphate)



Number of classes with confirmed resistance in at least one malaria vector in at least one monitoring site (2010–2020)

Professional & Public Health Customers Have Significant Unmet Needs:

> Problem 1:

Reduced activity due to increasing levels of resistance:

- □ Need new Modes of Action
- Need New products able to kill resistant populations
- > Problem 2:

Toxicity to humans & poor environmental safety (eg aquatic, bees)
Need - *lower toxicity and eco-friendly degradation properties*

Urban Threat From A New Type of Mosquito:

- Anopheles Stephensi has adapted to:
- 1. have resistance to all current insecticides
- 2. thrive in urban environments
- 3. survive wider temperatures
- 4. bite at a wider range of times





Flavocide[®] & Qcide[®] Active Constituents





Flying & Crawling Insects: A Large Commercial Opportunity Professional vector control market is approximately A\$840M p.a.¹



The Global mosquito control market size is projected to grow by 38% between 2021 and 2026.¹



Figure: Top 10 mosquito control manufacturers (revenue) market share in 2020.¹

In 2020, the regional split by sales volume and value was:

	Sales (%):	Value (US\$M)
#1 North America	31.2%	\$198.1
#2 Asia-pacific	28.4%	\$176.0
#3 Europe	20.4%	\$133.8
#4 South America	11.2%	\$62.9
#5 Middle East & Africa	8.8%	\$43.8



Figure: Global mosquito control market size (M, US\$, 2016 – 26).¹



Flavocide[®] for Use As a Stored Grain Protectant Infested grain is not acceptable.

The tolerance for live storage pests in grain sold off-farm either for Zero the domestic, human consumption market or for the export Tolerance market is **nil**. Cumulative weight loss of stored wheat as a result of feeding by Grain the lesser grain borer is approx. 56.9% over a two-month period.² Losses Current protectants: Deltamethrin - pyrethroid Spinosad – spinosyn (Lesser grain borer only) S-methoprene – insect growth regulator Current Solutions Chlorpyrifos-methyl - organophosphate Fenitrothion – organophosphate No chemical - cold storage-CO2. No single chemistry controls all pests. Research undertaken in Australia has confirmed: · populations of the Lesser grain borer that are highly resistant to deltamethrin; Resistance **Problems** control of the Lesser grain borer is no longer possible with organophosphates; and resistance to S-methoprene (IGR) is becoming common.¹

Pest (Scientific name) **Resistance (Chemical class)** Flat grain beetle **Phosphine** (Cryptolestes) Saw-toothed grain beetle Organophosphates (Oryzaephilus) Lesser grain borer Organophosphates + (Rhyzopertha dominica) **Pyrethroids Rice Weevil** Organophosphates (Sitophilus oryzae) Red-rust flour beetle Synthetic Pyrethroid (Tribolium castaneum) There is a strong need for a new mode of Unmet action to combine with current Need treatments.





Rust red flour beetle



Rice weevi





1. Prevalence of resistance to deltamethrin on Rhyzopertha dominica (F.) in eastern Australia", Daglish & Nayak DAF QLD, 2018 2. Loss of wheat weight from feeding of lesser grain borer", Rao & Wilbur, 1972

3. Market Data Forecast – Grains Protectants Market (2023)

Flavocide® for Use As a Stored Grain Protectant A potential new option to protect against resistant insects.

Bio-Gene has to date undertaken significant research on the potential to develop and commercialise Flavocide as a stored grain protectant.

Key Result 1 Research on combinations of Flavocide, chlorpyrifos-methyl and deltamethrin has **confirmed ability to provide residual control of all five of the major grain storage pests for up to nine months**.

Key Result 2 Flavocide controls Lesser grain borer (resistant strain) in multiple grains including wheat, maize & barley.

The GRDC and DAF Queensland have provided valuable support for this opportunity and has indicated that further support can be made available if Bio-Gene is able to secure a potential commercial partner able to provide a future route to market.



Damage to grain during storage due to infestation leads to significant risk of loss of income due to rejection. The global grain protectants market is estimated to generate revenues of US\$750M by 2026.

An inability to manage insect contamination of grain can severely impact Australia's reputation as an exporter of quality grain, especially wheat.³

The key suppliers:

- Sumitomo Chemical
- Bayer
- Corteva
- Nufarm
- UPL

- Central Life Sciences
- Syngenta
- Arysta LifeScience
- Hedley Technologies
- Degesch America



Lesser grain borer



Rust red flour beetle



Rice weevil



grain beetle

Qcide[®] - a Natural Product for Consumer Use For flying, crawling and sucking pests in the home and garden.



Consumer Segments

• Garden:

- Lawn care, ornamentals, fruit & vegetables
- Lawn beetles, armyworm, ants; sprays, granules, hose-on
- Ornamentals esp. roses mites, aphids,
- Fruit & vegetables
- Home:
 - Flying insects flies, mosquitoes, fleas, bed bug, clothes/pantry moths
 - Crawling insects ants, cockroaches, spiders
 - Aerosols/trigger sprays, baits/gels & traps





Global Consumer Opportunity

- Consumer Drivers:
 - Fear of human diseases carried by mosquitoes, ticks
- Fear of other biting insects bed bugs, spiders, ants
- Homes in urban environments with gardens and potted plants
- Increased interest in flowers and ornamentals to beautify the home environment
- Increased interest in fruit and vegetables to address cost of living increases & supply chain issues
- Global Demands:
 - Rapid urbanisation and rise in disposable income in emerging economies
 - Public health concerns (mosquitoes, ticks, cockroaches) & intolerance of biting insects



- Current Consumer Products:
- Mineral oils (stand alone)
- Toxic synthetics (e.g malathion)
- Pyrethum based products and combinations with canola oil
- Suppliers:

•

- Specialists dominated by large multinational companies e.g., SC Johnson (Raid), Reckitt-Benckiser (Mortein) and strong national brands (Yates)
- R&D based with innovation in active ingredient, formulations and delivery devices
- Distributors:
 - Supermarkets and hardware chains
 - Influenced by consumer expectations & preferences (safety to humans, children, pets, environment)



Unmet Needs

- Changing Consumer Environment:
- ✓ Shift towards safe (especially to children & pets) and ecofriendly products to protect the environment
- ✓ Chemical based products under regulatory and media scrutiny with loss of previously widely used chemical insecticide products (e.g., imidacloprid (bees), chlorpyrifos (safety), bifenthrin (aquatic toxicity))
- Natural products satisfy requirement for both safe and environmentally friendly products
- ✓ Creates opportunity for safe and effective replacement products including natural botanicals

BIO-GENE

Qcide ® - a Natural Product for Consumer Use For flying, crawling and sucking pests in the home and garden.

A Range of Products	 Qcide may be used alone or in combination and in a range of formulation types, to target multiple pests in several key use areas. May be formulated to target specific indoor/outdoor home/garden pest scenarios. 	
Multiple Use Patterns	 Formulations and mixtures to suit target pest and use pattern e.g: aerosol for indoor flying and/or crawling insects outdoor foliar spray mixture (mineral oil, other ai) for fruit & vegetable pests (bugs, leaf minor, caterpillars, aphids, mites) outdoor spray, hose on, granule for control of caterpillars, beetle larvae and ants in lawns 	
A Large Opportunity	 Market size of global home & garden pesticide market forecast to reach US\$12.2b by 2031 The global home and garden pesticides market size was estimated at USD 8.14 billion in 2022 and is expected to grow at a compound annual growth rate (CAGR) of 6.0% from 2023 to 2030. 	

Development stage gate status: Definition (PoC) Validation (R&D) Regulatory development Launch (market)



Bio-Gene's Strategic Priorities



Speed

particularly the pre-registration manufacturing and safety studies for Flavocide and Qcide active ingredients.



Focused Product Development

to deploy our resources against a pipeline of the most commercially attractive development products and partnered programs (both as stand-alone and combination products) that can be developed as soon as possible.



Commercial Validation

to build on existing commercial partnerships and secure the resources of additional larger partners and funding organisations to support the development of additional commercially attractive botanically derived insecticides.



Efficient Use of Capital

to leverage the funding from shareholders wherever possible with partner contributions and grants.



Bio-Gene's Board and Management Team

Strong experience in new product development and international partnering.



Bio-Gene – Key Corporate Metrics



Corporate Fundamentals			
Market Capitalisation	Approx A\$ 10.9M		
Listing	ASX:BGT		
Shares on issue	201,361,570		
Average Daily Trading	60.823		

Financial Position			
Cash Balance (30 Sep 23)	A\$ 3.48 million		
Runway:	Q2 CY2024		



Bio-Gene Investment Proposition



BIO-GENE



Developing New Insecticides Derived From Nature to Achieve High Impact - Globally

Bio-Gene Technology Limited

ASX:BGT

bgt.info@bio-gene.com.au

www.bio-gene.com.au

Registered Office Level 6 400 Collins Street Melbourne, Victoria, 3000 AUSTRALIA



