Review of Fire Ant Movement Controls

Terms of Reference

Effective date: 29/01/2020

Last Reviewed: 25/02/2020

Control Page

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Status: Approved

Version: Version 2

Document history

Version	Date	Release information	Author/s	Reviewer/s
1	15/11/2019	Sent to Management for approval	Sonia Marsanic	Heather Leeson, Ben Westlake, Ross Wylie, Liz Williams
2	19/11/2019	Amended and sent to the General Manager for approval	Sonia Marsanic	Graeme Dudgeon
3	20/12/2019	Sent to the Steering Committee for endorsement	Sonia Marsanic	Wendy Craik, Karina Keast, John Van Schagen
4	29/01/2020	Amended following feedback from the Steering Committee. Approved	Sonia Marsanic	Graeme Dudgeon, Andrew Turley, Heather Leeson, Ben Westlake
5	25/02/2020	Amended to clarify purpose of document	Andrew Turley	Graeme Dudgeon

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Purpose

The purpose for the review of the fire ant movement controls and scientific principles for the National Red Imported Fire Ant Eradication Program (the Program) is to ensure they provide a sound basis for addressing the risk across all Australian jurisdictions and affected industries of the red imported fire ant (RIFA) spreading through human assisted movement. The review will be conducted by an external party independent to the Program to ensure there is no partiality demonstrated toward the current scientific principles and movement controls in place. The review will include, but is not limited to:

- undertake a comprehensive review of materials capable of harbouring red imported fire ants (including a minimum of Appendix 1), and assess the relative levels of risk of fire ant spread posed by the human assisted movement of these identified materials
- assess the effectiveness of measures currently in place to mitigate the risk of spread
- undertake a review of the scientific and grey literature, as well as seeking expert entomological/biosecurity knowledge independent to the Program, drawing on experiences from other countries
- engage with relevant stakeholders such as the Program, peak industry bodies and interstate regulators
- make recommendations for improvements or further research.

General responsibilities

- Review scientific principles and the literature that underpins them and provide recommendations and advice.
- Review current fire ant carriers and movement controls in place within South East Queensland and interstate and provide recommendations and advice applicable across all jurisdictions.
- Determine the risk associated with the movement of each fire ant carrier and provide advice on appropriate mitigation.
- Report on the information provided by relevant stakeholders, interstate regulators and international biosecurity groups and provide recommendations.
- Based on the findings, identify constraints and provide evidence-based recommendations and advice for the future direction of the scientific principles and movement controls of carriers for the Program.
- Report all findings and recommendations to the Program.

Background

The Program was established in 2001 in response to the discovery of the Red Imported Fire Ant (*Solenopsis invicta*) in western Brisbane and Fisherman Island. The program has successfully eradicated the Fisherman Island infestation and several new incursions but eradication of the Western Brisbane population is ongoing. During an independent review in 2015-2016, it was determined that eradication was feasible and cost-beneficial in comparison to long term cost associated with environmental, social, health and economic impacts seen in other countries. A Ten Year Eradication Plan (Ten Year Plan) was developed to provide a comprehensive strategy and plan to eradicate the fire ants from South East Queensland (SEQ).

Fire ants are a serious pest in agricultural and urban areas and their ability to relocate and utilise disturbed landscapes make them well adapted. As a result, the risk of establishment following human-assisted movement outside the current area of infestation is great. The Program has developed scientific principles and practical measures that underpin the Programs movement control measures to prevent the human-assisted spread of fire ants. These scientific principles have been developed using published scientific and grey literature (Appendix 1). Experiences from other countries have also been used to determine how the spread of ants occurred through human assisted movement in order to determine the best form of prevention, control and ultimately eradication. The principles are used to assess risk mitigation measures to ensure that the movement of materials is at an acceptable (low) level of risk of moving a viable fire ant colony with the product.

It has been well documented that fire ants spread through the movement of various carrier materials including potted plants, nursery stock, mulch, turf and hay (refer to Appendix 2 for a full list of carriers). The *Biosecurity Regulation 2016* prescribes the fire ant carriers the Program recognises as high-risk products as well as procedures that must be followed when moving or storing a fire ant carrier. In addition, the *Biosecurity Act 2014* (the Act) establishes a general biosecurity obligation (GBO) for individuals and organisations involved in the movement or storage of fire ant carriers to take all reasonable steps to ensure they do not spread fire ants. Biosecurity zones have also been established in the infestation areas to prevent further movement.

In conjunction with the fire ant biosecurity zones in SEQ, the Program has worked closely with all States and Territories in Australia to ensure the movement of these carriers does not pose a high risk of fire ant movement. This risk is largely associated with the movement of plants and their products. Various measures and considerations of appropriate mitigation measures have been used in the past. These measures and scientific knowledge of the fire ant have been considered by the National Exotic Invasive Ant Scientific Advisory Group (SAG) to establish the current scientific principles and movement controls in place by the Program. Due to the nature of the fire ant, using the knowledge and experience of other countries and current biosecurity measures, the most appropriate risk mitigation can be determined and managed appropriately to prevent further incursions.

Authority

The successful external party will provide the Program with a report outlining their assessment and recommendations on the current scientific principles and movement controls in place to minimise the risk for fire ant spread through associated carriers.

Timeframes

The Program has requested the review to be completed within a three month period from the date of allocation to the appropriate external party. The time frame will be negotiated resultant of the negotiated financial requirements. Additional time may be afforded to the successful party through negotiation with the Program prior to commencement where sufficient justification can be demonstrated.

Accountability

The external party will remain accountable for providing the required advice and recommendations by the appropriate outlined timeframes from the Program. It is the responsibility of the external party to ensure it has its own defined methodology and staffing in order to ensure the review is completed, meeting the general responsibilities and purpose for the review.

Delegations

Delegation will be at the discretion of the Program in line with governmental policies and procedures to ensure the appropriate external party is selected for the review. The external party will ensure all the reporting requirements outlined by the Program are met in the nominated timeframes. For timeframe adjustments or scope amendments, the Program will be consulted and approval granted before the requested changes are made.

Confidentiality

All members associated with the review are required to maintain confidentiality of information obtained in the course of their duties. Information will not be released to third parties unless required and authorised by the Program. Information will only be used for the purpose for which it was obtained.

Appendix 1 – Scientific Principles and Bibliography

SCIENTIFIC PRINCIPLES FOR INDUSTRY MOVEMENT OF CARRIERS

The following scientific principles and practical measures underpin the National Red Imported Fire Ant Eradication Program's movement control measures for red imported fire ants (fire ant), as well as add new principles as suggested by the Scientific Advisory Group (meeting held in February 2019). This document has been developed by the Program through extensive analysis of the available scientific literature and through discussions with fire ant experts based in the United States of America and New Zealand. These experts include entomologists in the United States Department of Agriculture and leading research bodies and universities.

Principles are based on knowledge at the time of development of that principle, and should be adapted with new information. As research continues into fire ants and their invasion biology in a global context, these principles may be changed/updated in the future in light of new knowledge.

Principles	Scientific Rationale	Practical Measures & Examples
An established fire ant queen will not survive without workers, so if a queen is permanently separated from the majority of her workers, she will perish.	It is likely that the minimum number of workers required for queen survival throughout the life of the colony equates to the minimum number of workers required during nest establishment (i.e. 10-25) (Tschinkel 2006). This is because when a newly mated queen starts a nest, she draws on her stored energy reserves to lay a first clutch of eggs and is then tended by a small group of workers until the nest establishes. However, when the queen starts egg laying in earnest, she does not forage or feed herself but relies on her worker ants. To mitigate the potential spread of fire ants in a fire ant carrier, the separation of a queen from her workers needs to be such that workers cannot subsequently relocate their queen after the disturbance has taken place (SAG 2019).	Application of some form of risk mitigation is needed to disturb a fire ant colony prior to movement of the carrier off site. Disturbance must be sustained and vigorous enough to prevent the colony from recovering, such as workers relocating their queen after the disturbance has taken place. Inadequate storage of the carrier will require some form of risk mitigation (disturbance, chemical or heat) prior to movement off site.
It takes approximately 21 days for a fire ant colony to establish, so any disturbance of the nest during this time is likely to result in death of the new colony.	The claustral period (initial establishment of nest, first egg-laying, larval stage, pupal stage and first foraging by emerging adults) lasts from 3-4 weeks depending on temperature. It is this claustral period that has the most risk and highest fatality rates for fire ant – any disturbance, causing separation of the queen from its workers during this time is likely to result in death of the new colony (Tschinkel 2006).	Disturbance – for carriers that have been stockpiled, disruption of a fire ant colony can be in the form of screening, shredding, complete turning, grinding, crushing or chipping. Stockpiles must be re-disturbed every 21 days to address the potential for fly-ins and ensure any newly formed nest is adequately disrupted. For example, for hay, which is a high risk carrier, the final raking of the hay and the subsequent raking plus

		baling are done within 24 hours of each other; baled hay must also be removed from the paddock it was baled in within 24 hours.
High temperatures can either repel or kill fire ants, so carriers that are heated to these temperatures are unlikely to harbour fire ants.	In a controlled environment experiment, fire ants became agitated and attempted to leave their surroundings when the temperature reached 38.3°C. At 46°C, the fire ants started to slow in movement, with death occurring at 51°C. (Bauer 2014) In another study, fire ant upper critical thermal limit has been recorded at 40.7°C (Cokendolpher and Phillips 1990). In Texas, fire ant foraging activity reduced when temperatures were above 40 °C (Porter and Tschinkel 1987).	Heating to at least 40°C can disturb/repel a fire ant colony enough to get the colony to disinfest the product temporarily. The product would need to remain at or above this temperature for continued repellence. To kill fire ants within a product, heating needs to be above 50°C to ensure death of any fire ants present. For example, composting methods that reach temperatures above 60°C will kill any fire ants present. However, treatment or further risk mitigation strategies may be needed around the piles/around the outside due to these areas not reaching the required temperatures to disinfest or kill any fire ants present.
While the main nest chamber of a newly established or young fire ant colony in the ground is usually located within the top one metre of soil, some chambers may be lower; therefore, there is still a risk of colony spread due to disturbance and queen protection behaviour if the top layer of soil is removed.	Markin *et al.* (1973) studied fire ant colonies and maturing mounds and found the spongelike internal structure typical of the interior of mounds extended down into the ground in the shape of an inverted cone. The apex of the inverted cone would be approximately 60 cm below the soil surface, with several large tunnels extending downwards an additional metre or more at the approximate level of the water table.	Only at sites that have been surveyed and found to contain no infestation of fire ants is there minimal risk of moving fire ants after the top one metre of soil has been removed. Sites where there are infestation, or are surrounded by infestation still poses a risk of spread regardless of how much of the profile is removed. Sites where there is nearby infestation or are known to be infested have a high risk of moving fire ants and sufficient mitigation measures must be undertaken (*to be discussed at the next SAG meeting).
A monogyne colony fraction with no queens or alates is unlikely to cause further infestation.	A small group of fire ant workers from a monogyne nest, separated from their queen and nest-mates, is generally not a viable colony in its own right. Usually, when a colony loses the queen (due to death, pesticide, etc.), the colony dies (Tschinkel 2006). However, there are very rare circumstances where a queenless colony can survive:	A small group of monogyne workers separated from their queen presents a minimal spread risk to the Program.

	- A virgin female alate in the nest may take up the role of queen and produce eggs. However, as she is unfertilised, these eggs can only develop into male alates (Tschinkel 2006). - A newly mated female alate may be adopted (Vander Meer & Alonso 2002).	
Fire ants will not establish on impermeable surfaces.	Fire ants won't establish on a surface that is impermeable. However, they can damage hard surfaces such as bitumen roads by excavating soil underneath the road when nesting beside it (Banks et al. 1990), thus bitumen or compacted earth is not deemed impermeable.	Storage of carriers that have the potential to harbour fire ants need to be stored on an impermeable surface that has no cracks or damage to prevent infestation from surrounding soil. If this surface is compacted ground, then treatment is required in addition to any risk mitigation strategies already in place.
Nuptial flights can occur at any time of the year.	Although nuptial flights tend to occur in spring and early-mid summer when air temperatures are between 23°C and 33°C, they can take place at any time of the year. They have been observed flying at temperatures as low as 15°C (Xu *et al.* 2009). It appears that even during the colder seasons, if the temperatures are high enough during the day, a nuptial flight may take place on the second or third day following a rain event (Morrill 1974). The general consensus is that a minimum of 0.2–8.6 mm of rain must fall otherwise the ground will be either too dry or too wet for claustral chamber formation (Morrill 1974b; Bass & Hays 1979). Whitcomb *et al.* (1973) also states that large flights tend to occur during periods of high humidity following rainfall after weeks of drought early in the summer.	Nuptial flights are more frequent in spring to mid-summer, which means treatment early in the treatment season (i.e. September – October) is important. However, nuptial flights can occur at any time of year.

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Appendix 2 – Fire ant carriers

Recognised high-risk fire ant carriers includes:

- Baled hay or straw
- Potted plants
- Composted materials
- Soil
    - Fill
    - Clay
    - Scrapings
    - Any other material removed from the ground at a site where earthworks are being carried out
- Material that is a product or by-product of mining or quarrying such as;
    - Gravels
    - Sands
    - Chitters
    - Coal fines
    - Coal stone
    - Decomposed granite
    - Overburden
- Material that is a product or by-product of the processing of an animal, or something that comes from an animal
    - Solid waste produced by processing an animal at an abattoir
    - Animal manure
- Material that is a product or by-product of the processing of a plant, or something that comes from a plant
    - Mulch
    - Sawdust
    - Green waste
    - Compost
- A thing that has soil, or an organic soil substitute, attached to it such as;
    - Turf
    - An advanced plant with soil on its roots that has been removed from the ground for re-planting
    - An appliance that soil or another growing medium is attached to