The University *of* Western Ontario
BIOLOGICAL AGENTS REGISTRY FORM
Approved Biohazards Subcommittee: October 14, 2011
Biosafety Website: www.uwo.ca/humanresources/biosafety/

This form must be completed by each Principal Investigator holding a grant administered by the University of Western Ontario (UWO) or in charge of a laboratory/facility where the use of Level 1, 2 or 3 biological agents is described in the laboratory or animal work proposed. The form must also be completed if any work is proposed involving animals carrying zoonotic agents infectious to humans or involving plants, fungi, or insects that require Public Health Agency of Canada (PHAC) or Canadian Food Inspection Agency (CFIA) permits.

This form must be updated at least every 3 years or when there are changes to the biological agents being used.

Containment Levels will be established in accordance with Laboratory Biosafety Guidelines, 3rd edition, 2004, Public Health Agency of Canada (PHAC) or Containment Standards for Veterinary Facilities, 1st edition 1996, Canadian Food Inspection Agency (CFIA).

Electronically completed forms are to be submitted to Occupational Health and Safety, (OHS), (Support Services Building, Room 4190 or to jstanle2@uwo.ca) for distribution to the Biohazards Subcommittee. For questions regarding this form, please contact the Biosafety Officer at extension 81135 or biosafety@uwo.ca. If there are changes to the information on this form (excluding grant title and funding agencies), contact Occupational Health and Safety for a modification form. See website: www.uwo.ca/humanresources/biosafety.

Please ensure that all questions are fully and clearly answered. Failure to do so will lead to the form being returned, which will cause delays in your approval and frustration for you and your colleagues on the Committee.

If you are re-submitting this form as requested by the Biohazards Subcommittee, please make modifications to the form in bold print, highlighted in yellow. Please re-submit forms electronically.

PRINCIPAL INVESTIGATOR:	**Assistant Professor Graham J Thompson**
DEPARTMENT:	**Biology**
ADDRESS:	**Biological & Geological Sciences Building 2060**
PHONE NUMBER:	**x86570**
EMERGENCY PHONE NUMBER(S):	**519 516 6066**
EMAIL:	**gthomp6@uwo.ca**

Location of experimental work to be carried out :

Building : **B&GS** Room(s): **2060**
Building : Room(s):
Building : Room(s):

***For work being performed at Institutions affiliated with the University of Western Ontario, the Safety Officer for the Institution where experiments will take place must sign the form prior to its being sent to the University of Western Ontario Biosafety Officer (See Section 15.0, Approvals).**

FUNDING AGENCY/AGENCIES: **NSERC**
GRANT TITLE(S): **Evolutionary Genetics of Sociality**
UNDERGRADUATE COURSE NAME(IF APPLICABLE): **NA**

List all personnel working under Principal Investigators supervision in this location:

Name	UWO E-mail Address	Date of Biosafety Training
Catherine Gao	**qgao29@uwo.ca**	**21 Aug 2009**
Alison Camiletti	**acamilet@uwo.ca**	**25 Sept 2011**
Emma Mullen	**emullen@uwo.ca**	**21 April 2011**
David Awde	**dawde@uwo.ca**	**24 Oct 2011**

Please explain how the biological agents are used in your project and how they are stored and disposed of. The BARF without this description will not be reviewed.

Fungal culture and infectivity trails

We use an entomopathogenic strain of Metarhizium anisopliae (strain number 2575, ultimately from USDA collection, Ithaca, NY) to infect groups of termites. This native fungus is known to cause significant mortality in termites; it uses hydrolytic enzymes to penetrate the insect cuticle, subsequently the hyphae ramify the haemocoel. First, we plate conidia (asexual spores) of M. anisopliae onto potato dextrose agar (PDA) media plates, and culture them at 25°C in darkness. After approximately 14 days, we harvest the conidia by washing each plate with a sterile 0.01% Tween 80 solution, and then estimate the concentration of conidia in suspension using a conventional haemocytometer. From these washes, we make serial dilutions of known concentration (103, 105, and 107 spores/ml), and stored these (4°C) for no more than one week prior to using them in infectivity trials. Termites treated with spores, as well as unused paltes of spore culture or spore solutions, are disposed of as Biohazard Waste. As per procedure within the Dept of Biology, suhc waste is bagged, autoclaved and marked as 'Autoclaved Biohazard Waste' for special pick-up and disposal.

Please include a ONE page research summary or teaching protocol in lay terms.
Forms with summaries more than one page will not be reviewed.

Our lab uses an entomopathogenic fungus, Metarhizium anisopliae Strain 2575, to conduct infectivity trails and subsequent survivorship analysis on a species of insect, the eastern subterranean termite, Reticulitermes flavipes.

The fungus and the insect are both found locally in Ontario and thus are not exotic or imported.

The purpose of this research is to establish the fungal spore concentration at which small groups of termites become immune-challenged under different biological scenarios - for example, as singletons or in mixed social groups. Once established, the effective concentration will be used to induce the up-regulation of immune genes. These immune genes are the basis for further study at the molecular level.

This work is part of Ms Catherine Goa's graduate research. So far, she has two publications accepted or submitted from this work:

1) Gao Q, Tancredi SE, Thompson GJ 2012. Identification of mycosis-related genes in the Eastern subterranean termite by suppression subtractive hybridization. Archives of Insect Biochemistry and Physiology. AIBP-11-0123

2) Gao Q, Bidochka, M, Thompson GJ. 2011. Effect of group size and caste ratio on individual survivorship and social immunity in a subterranean termite. Acta Ethologica: DOI: 10.1007/s10211-011-0108-7

Dr Graham Thompson
X 86570

1.0 Microorganisms

1.1 Does your work involve the use of biological agents? ☒ YES ☐ NO
(non-pathogenic and pathogenic biological agents including but not limited to bacteria and other microorganisms, viruses, prions, parasites or pathogens of plant or animal origin)? If no, please proceed to Section 2.0

Do you use microorganisms that require a permit from the CFIA? ☐ YES ☒ NO
If YES, please give the name of the species ______________________
What is the origin of the microorganism(s)? ______________________

Please describe the risk (if any) of escape and how this will be mitigated: **There is no risk that the fungus will escape**

Please attach the CFIA permit.

Please describe any CFIA permit conditions:

1.2 Please complete the table below:

Full Scientific Name of Biological Agent(s)* (Be specific)	Is it known to be a human pathogen? YES/NO	Is it known to be an animal pathogen? YES/NO	Is it known to be a zoonotic agent? YES/NO	Maximum quantity to be cultured at one time? (in Litres)	Source/ Supplier	PHAC or CFIA Containment Level
Metarhizium anisopliae	☐ Yes ☒ No	☒ Yes ☐ No	☐ Yes ☒ No	<1	**Dr Michael Bidochka (Briock University)**	☒ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3
	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No			☐ 1 ☐ 2 ☐ 2+ ☐ 3

***Please attach a Material Safety Data Sheet or equivalent from the supplier if the bacterium used is not on this link:**
http://www.uwo.ca/humanresources/docandform/docs/ohs/CFIA_Ecoli_list.pdf

Additional Comments: ______________________

2.0 Cell Culture

2.1 Does your work involve the use of cell cultures? ☐ YES ☒ NO
(If NO, please proceed to Section 3.0)

2.2 Please indicate the type of primary cells (i.e. derived from fresh tissue) that will be grown in culture:

Cell Type	Is this cell type used in your work?	Source of Primary Cell Culture Tissue	AUS Protocol Number
Human	☐ Yes ☐ No		Not applicable
Rodent	☐ Yes ☐ No		
Non-human primate	☐ Yes ☐ No		
Other (specify)	☐ Yes ☐ No		

2.3 Please indicate the type of established cells that will be grown in culture in:

Cell Type	Is this cell type used in your work?	Specific cell line(s)*	Containment Level of each cell line	Supplier / Source of cell line(s)
Human	☐ Yes ☐ No			
Rodent	☐ Yes ☐ No			
Non-human primate	☐ Yes ☐ No			
Other (specify)	☐ Yes ☐ No			

Please attach a Material Safety Data Sheet or equivalent from the supplier. (For more information, see www.atcc.org)

2.4 For above named cell types(s) indicate PHAC or CFIA containment level required ☐ 1 ☐ 2 ☐ 2+ ☐ 3

Additional Comments: _____

3.0 Use of Human Source Materials

3.1 Does your work involve the use of human source materials? ☐ YES ☒ NO
If no, please proceed to Section 4.0

3.2 Indicate in the table below the Human Source Material to be used.

Human Source Material	**Source/Supplier /Company Name**	**Is Human Source Material Infected With An Infectious Agent? YES/UNKNOWN**	**Name of Infectious Agent (If applicable)**	**PHAC or CFIA Containment Level (Select one)**
Human Blood (whole) or other Body Fluid		☐ Yes ☐ Unknown		☐1 ☐2 ☐2+ ☐3
Human Blood (fraction) or other Body Fluid		☐ Yes ☐ Unknown		☐1 ☐2 ☐2+ ☐3
Human Organs or Tissues (unpreserved)		☐ Yes ☐ Unknown		☐1 ☐2 ☐2+ ☐3
Human Organs or Tissues (preserved)		Not Applicable		Not Applicable

Additional Comments: _____

4.0 Genetically Modified Organisms and Cell lines

4.1 Will genetic modifications be made to the microorganisms, biological agents, or cells described in Sections 1.0 and 2.0? ☐ YES ☒ NO If **NO**, please proceed to Section 5.0

4.2 Will genetic modification(s) involving plasmids be done? ☐ YES, complete table below ☐ NO

Bacteria Used for Cloning *	Plasmid(s) **	Source of Plasmid	Gene Transformed or Transfected	Will there be a change due to transformation of the bacteria?	Will there be a change in the pathogenicity of the bacteria after the genetic modification?	What are the consequences due to the transformation of the bacteria?

**** Please attach a Material Safety Data Sheet or equivalent if available.***
***** Please attach a plasmid map.***
******No Material Safety Data Sheet is required for the following strains of E. coli:***
http://www.uwo.ca/humanresources/docandform/docs/ohs/CFIA_Ecoli_list.pdf

4.3 Will genetic modification(s) of bacteria and/or cells involving viral vectors be made?
☐ YES, complete table below ☐ NO

Virus Used for Vector Construction	Vector(s) *	Source of Vector	Gene(s) Transduced	Describe the change that results from transduction

**** Please attach a Material Safety Data Sheet or equivalent.***

4.3.1 Will virus be replication defective? ☐ YES ☐ NO

4.3.2 Will virus be infectious to humans or animals? ☐ YES ☐ NO

4.3.3 Will this be expected to increase the containment level required? ☐ YES ☐ NO

5.0 Will genetic sequences from the following be involved?

- HIV ☒ NO ☐ YES, specify
- HTLV 1 or 2 or genes from any Level 1 or Level 2 pathogens ☒ NO ☐ YES, specify
- SV 40 Large T antigen ☒ NO ☐ YES
- E1A oncogene ☒ NO ☐ YES
- Known oncogenes ☒ NO ☐ YES, specify
- Other human or animal pathogen and or their toxins ☒ NO ☐ YES, specify

5.1 Is any work being conducted with prions or prion sequences? ☒ NO ☐ YES

Additional Comments: _____

6.0 Human Gene Therapy Trials

6.1 Will human clinical trials be conducted involving a biological agent? ☐ YES ☒ NO
(including but not limited to microorganisms, viruses, prions, parasites or pathogens of plant or animal origin)
If no, please proceed to Section 7.0

6.2 If YES, please specify which biological agent will be used:
Please attach a full description of the biological agent.

6.3 Will the biological agent be able to replicate in the host? ☐ YES ☐ NO

6.4 How will the biological agent be administered?

6.5 Please give the Health Care Facility where the clinical trial will be conducted:

6.6 Has human ethics approval been obtained? ☐ YES, number: ☐ NO ☐ PENDING

7.0 Animal Experiments

7.1 Will live animals be used? ☐ YES ☒ NO If **NO**, please proceed to section 8.0

7.2 Name of animal species to be used **Insects only (termites)**

7.3 AUS protocol #

7.4 List the location(s) for the animal experimentation and housing.

7.5 Will any of the agents listed in section 4.0 be used in live animals
☐ NO ☐ YES, specify:

7.6 Will the agent(s) be shed by the animal:
☐ YES ☐ NO, please justify:

See E-mail

8.0 Use of Animal species with Zoonotic Hazards

8.1 Will any animals with zoonotic hazards or their organs, tissues, lavages or other body fluids including blood be used (see list below)? ☐ YES ☐ NO - If **NO**, please proceed to section 9.0

8.2 Will live animals be used? ☐ YES ☐ NO

8.3 If **YES**, please specify the animal(s) used:

♦ Pound source dogs	☐ YES	☐ NO
♦ Pound source cats	☐ YES	☐ NO
♦ Cattle, sheep or goats	☐ YES, species	☐ NO
♦ Non-human primates	☐ YES, species	☐ NO
♦ Wild caught animals	☐ YES, species & colony #	☐ NO
♦ Birds	☐ YES, species	☐ NO
♦ Others (wild or domestic)	☐ YES, specify	☐ NO

8.4 If no live animals are used, please specify the source of the specimens:

9.0 Biological Toxins and Hormones

9.1 Will toxins or hormones of biological origin be used? ☐ YES ☒ NO If **NO**, please proceed to Section 10.0

9.2 If YES, please name the toxin(s) or hormones(s)
Please attach information, such as a Material Safety Data Sheet, for the toxin(s) used.

9.3 What is the LD_{50} (specify species) of the toxin or hormone

9.4 How much of the toxin or hormone is handled at one time*?

9.5 How much of the toxin or hormone is stored*?

9.6 Will any biological toxins or hormones be used in live animals? ☐ YES ☐ NO
If **YES**, Please provide details:

*For information on biosecurity requirements, please see:
http://www.uwo.ca/humanresources/docandform/docs/healthandsafety/biosafety/Biosecurity_Requirements.pdf

Additional Comments: _____

10.0 Insects

10.1 Do you use insects? ☒ YES ☐ NO - If **NO**, please proceed to Section 11.0

10.2 If YES, please give the name of the species. **Reticulitermes flavipes**

10.3 What is the origin of the insect? **Southern Ontario**

10.4 What is the life stage of the insect? **All stages (Imagoes, nymphes, workers, soldiers)**

10.5 What is your intention? ☒ Initiate and maintain colony, give location: **BGS2060**
☐ "One-time" use, give location:

10.6 Please describe the risk (if any) of escape and how this will be mitigated:
Risk of escape is remote. They are contained within plastic constainers, that are themselves submerged into a water moat.

10.7 Do you use insects that require a permit from the CFIA permit? ☐ YES ☒ NO
If **YES**, Please attach the CFIA permit & describe any CFIA permit conditions:

11.0 Plants

11.1 Do you use plants? ☐ YES ☒ NO - If **NO**, please proceed to Section 12.0

11.2 If YES, please give the name of the species.

11.3 What is the origin of the plant?

11.4 What is the form of the plant (seed, seedling, plant, tree…)?

11.5 What is your intention? ☐ Grow and maintain a crop ☐ "One-time" use

11.6 Do you do any modifications to the plant? ☐ YES ☐ NO
If yes, please describe:

11.7 Please describe the risk (if any) of loss of the material from the lab and how this will be mitigated:

11.8 Is the CFIA permit attached? ☐ YES ☐ NO
If **YES**, Please attach the CFIA permit & describe any CFIA permit conditions:

12.0 Import Requirements

12.1 Will any of the above agents be imported? ☐ YES, country of origin ☒ NO
If **NO**, please proceed to Section 13.0

12.2 Has an Import Permit been obtained from HC for human pathogens? ☐ YES ☐ NO

12.3 Has an import permit been obtained from CFIA for animal or plant pathogens? ☐ YES ☐ NO

12.4 Has the import permit been sent to OHS? ☐ YES, please provide permit # ☐ NO

13.0 Training Requirements for Personnel Named on Form

All personnel named on the above form who will be using any of the above named agents are required to attend the following training courses given by OHS:

- Biosafety
- Laboratory and Environmental/Waste Management Safety
- WHMIS (Western or equivalent)
- Employee Health and Safety Orientation

As the Principal Investigator, I have ensured that all of the personnel named on the form who will be using any of the biological agents in Sections 1.0 to 9.0 have been trained.

An X in the check box indicates you agree with the above statement... ☒
Enter Your Name Graham J Thompson ***Date:*** 3 January 2012

14.0 Containment Levels

14.1 For the work described in sections 1.0 to 9.0, please indicate the highest HC or CFIA Containment Level required. ☒ 1 ☐ 2 ☐ 2+ ☐ 3

14.2 Has the facility been certified by OHS for this level of containment?
☒ YES, location and date of most recent biosafety inspection: **BGS2060 (Dec 2011)**
☐ NO, please certify
☐ NOT REQUIRED for Level 1 containment

14.3 Please indicate permit number (not applicable for first time applicants):

15.0 Procedures to be Followed

15.1 Are additional risk reduction measures necessary beyond containment level 1, 2, 2+ or 3 measures that are unique to these agents? ☐ YES ☒ NO
If **YES** please describe:

15.2 Please outline what will be done if there is an exposure to the biological agents listed such as a needlestick injury or an accidental splash:
Just wash with soapy water, not pathogenic to humans.

15.3 As the Principal Investigator, I will ensure that this project will follow the Western Biosafety Guidelines and Procedures Manual for Containment Level 1 & 2 Laboratories (and the Level 3 Facilities Manual for Level 3 projects). I will ensure that UWO faculty, staff and students working in my laboratory have an up-to-date Hazard Communication Form, found at http://www.shs.uwo.ca/workplace/workplacehealth.html

An X in the check box indicates you agree with the above statement... ☒
Enter Your Name **Graham J Thompson** ***Date:*** **3 January 2012**

15.4 Additional Comments: _____

16.0 Approvals

1) UWO Biohazards Subcommittee:
SIGNATURE: _____
Date: _____

2) Safety Officer for the University of Western Ontario
SIGNATURE: _____
Date: _____

3) Safety Officer for Institution where experiments will take place (if not UWO):
SIGNATURE: _____
Date: _____

Approval Number: _____ Expiry Date (3 years from Approval): _____

Special Conditions of Approval:

------- Original Message --------
Subject: Re: Biological Agents Registry Form - Thompson - SECOND REQUEST
Date: Wed, 04 Jan 2012 10:16:10 -0500
From: Graham Thompson <graham.thompson@uwo.ca>
To: Jennifer Stanley <jstanle2@uwo.ca>

E-mail

Hi Jennifer,

Correct, that is a NO.

Cheers,

Graham

On 2012-01-04, at 10:12 AM, Jennifer Stanley wrote:

Hi there -
I noticed that Section 8.0, Use of Animal species with Zoonotic Hazards, was missed:
8.1 Will any animals with zoonotic hazards or their organs, tissues, lavages or other body fluids including blood
be used (see list below)? YES NO - If NO, please proceed to section 9.0
I assume that this is NO?
Regards
Jennifer

-------- Original Message --------
Subject: Re: Biological Agents Registry Form - Thompson - SECOND REQUEST
Date: Wed, 04 Jan 2012 09:55:46 -0500
From: Graham Thompson <graham.thompson@uwo.ca>
To: Jennifer Stanley <jstanle2@uwo.ca>

Whoops. sorry about that.

<barf_GThompson2012.pdf><Attached Message Part.html>

Graham Thompson
Assistant Professor
Department of Biology
University of Western Ontario
1151 Richmond Street North
London, Ontario N6A 5B7
CANADA

519 661 2111 (ext 86570)
519 615 6066 (iPhone)
graham.thompson@uwo.ca
http://www.uwo.ca/biology/Faculty/thompson

From: ImportZoopath <ImportZoopath@inspection.gc.ca>
Subject: **Re: CFIA containment question**
Date: January 12, 2009 12:07:46 PM GMT-05:00
To: Graham Thompson <graham.thompson@uwo.ca>
1 Attachment, 0.2 KB

Dear Ms Thompson,

Our organism database di not have this organism listed so I did a quick research to see how it would be classified. I only found one article detailing this organism infecting a cat. Knowing this an organism research/used intensively as a biocontrol agent, this only case does not reflect an high pathogenicity.

I have decided to classify this organism as a level 1 organism, and therefore if you decide to import this organism, you will not need an import permit from my group.

Have a nice day,

Cinthia Labrie

Office of Biohazard Containment & Safety, CFIA I Bureau du confinement des biorisques et de la sécurité, ACIA
Government of Canada I Gouvernement du Canada
59 Camelot, Ottawa ON K1A0Y9
Phone/Tél.: (613) 221-7068
Fax/ Téléc.: (613) 228-6129
ImportZoopath@inspection.gc.ca

Please visit our website at: http://www.inspection.gc.ca/english/sci/bio/bioe.shtml
Veuillez visiter notre site internet au: http://www.inspection.gc.ca/francais/sci/bio/biof.shtml

| | | Graham Thompson <graham.thompson@uwo.ca> 2009-01-12 11:07:44 >>>
Dear CFIA

I was hoping to learn whether a species of entomopathogenic fungus, Metarhizium anisopliae, is listed as an organism of interest with CFIA of Health Canada, and if so, what Level of Containment (1, 2, 3 or 4) should it be listed under.

Is there are database that I can search for this information?

Many thanks for any advice,

Graham

Graham Thompson
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CANADA

519 661 2111 (ext 86570)
519 615 6066 (cell)
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ImportZoopath.vcf (0.2 KB)

Metarhizium anisopliae

From Wikipedia, the free encyclopedia

Metarhizium anisopliae, formerly known as *Entomophthora anisopliae* (basionym), is a fungus that grows naturally in soils throughout the world and causes disease in various insects by acting as a parasitoid. Ilya I. Mechnikov named it after the insect species it was originally isolated from: the beetle *Anisoplia austriaca*. It is a mitosporic fungus with asexual reproduction, which was formerly classified in the form class Hyphomycetes of the form phylum Deuteromycota (also often called Fungi Imperfecti).

It has long been recognised that many isolates are specific, and they were assigned variety status[1], but they have now been assigned as new *Metarhizium* species[2], such as *M. anisopliae*, *M. majus* and *M. acridum* (which was *M. anisopliae* var. *acridum* and included the isolates used for locust control). *Metarhizium taii* was placed in *M. anisopliae* var. *anisopliae*[3], but has now been described as a synonym of *M. guizhouense* (see *Metarhizium*).

Contents

Biology

The disease caused by the fungus is sometimes called **green muscardine disease** because of the green colour of its spores. When these mitotic (asexual) spores (called conidia) of the fungus come into contact with the body of an insect host, they germinate and the hyphae that emerge penetrate the cuticle. The fungus then develops inside the body eventually killing the insect after a few days; this lethal effect is very likely aided by the production of insecticidal cyclic peptides (destruxins). The cuticle of the cadaver often becomes red. If the ambient humidity is high enough, a white mould then grows on the cadaver that soon turns green as spores are produced. Most insects living near the soil have evolved natural defenses against entomopathogenic fungi like *M. anisopliae*. This

Metarhizium anisopliae

Cockroach killed by *M. anisopliae*

Scientific classification

Kingdom:	Fungi
Subkingdom:	Dikarya
Phylum:	Ascomycota
Class:	Sordariomycetes
Order:	Hypocreales
Family:	Clavicipitaceae
Genus:	*Metarhizium*
Species:	***M. anisopliae***

Binomial name

Metarhizium anisopliae

(Metchnikoff) Sorokin

fungus is therefore locked in an evolutionary battle to overcome these defenses, which has led to a large number of isolates (or strains) that are adapted to certain groups of insects[4].

Economic Importance

This entomopathogenic fungus is known to infect over 200 insect pest species, including termites[5]. It is currently being used as a biological insecticide to control a number of pests such as termites, thrips, etc. and its use in the control of malaria-transmitting mosquitoes is under investigation[6]. *M. anisopliae* does not appear to infect humans or other animals and is considered safe as an insecticide. The microscopic spores are typically sprayed on affected areas. A possible technique for malaria control is to coat mosquito nets or cotton sheets attached to the wall with them.

In August 2007, a team of scientists at the Indian Institute of Chemical Technology discovered a more efficient way of producing biodiesel which uses lipase, an enzyme produced in significant quantities by *Metarhizium anisopliae*; as opposed to other reactions which use enzymes that require heat in order to become active, the reaction that uses lipase runs at room temperature. The fungus is now a candidate for mass production of the enzyme.

Important Isolates

- The the ex-neotype isolate of *M. anisopliae* is IMI 168777ii = ARSEF 7487 (also CSIRO FI-1029) from *Schistocerca gregaria* in Eritrea
- *M. anisopliae* isolate F52 (029056) primarily infects beetle larvae[7]: it is the active ingredient of 'BIO 1020', originally developed for control of *Otiorhynchus sulcatus* and now 'Met52'[8]
- A.C. Rath's isolate F506 (= ARSEF 4556; DAT 506; IMI 384583) from *Boophilus* sp. (Acari: Ixodidae) in USA (Florida)
- *M. anisopliae* isolated from *Dermolepida albohirtum* (Coleoptera: Scarabaeidae) include: CSIRO FI-1358 (= ARSEF 7493) and FI 1045 which is the active ingredient of 'Biocane'.

See also

- Beauveria bassiana, the fungus that causes *white muscardine disease* in various insects
- Biological insecticides
- LUBILOSA

References

1. ^ Driver, F., Milner, R.J. and Trueman, W.H.A. (2000). "A Taxonomic revision of *Metarhizium* based on sequence analysis of ribosomal DNA". *Mycological Research* **104** (2): 135–151. doi:10.1017/S0953756299001756 (http://dx.doi.org/10.1017%2FS0953756299001756) .
2. ^ Bischoff J.F., Rehner S.A. Humber R.A. (2009). "A multilocus phylogeny of the *Metarhizium anisopliae* lineage". *Mycologia* **101** (4): 512–530. doi:10.3852/07-202 (http://dx.doi.org/10.3852%2F07-202) . PMID 19623931 (http://www.ncbi.nlm.nih.gov/pubmed/19623931) .
3. ^ Huang B., Li C., Humber R.A., Hodge K.T., Fan M. and Li Z. (2005). "Molecular evidence for the taxonomic status of *Metarhizium taii* and its teleomorph, *Cordyceps taii* (Hypocreales, Clavicipitaceae)". *Mycotaxon* **94**: 137–147.
4. ^ Freimoser, F. M., Screen, S., Bagga, S., Hu, G. and St. Leger, R.J. (2003). "EST analysis of two subspecies of *Metarhizium anisopliae* reveals a plethora of secreted proteins with potential activity in insect hosts".

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External links

- Index Fungorum record (http://www.indexfungorum.org/Names/namesrecord.asp?RecordID=199430) , links to a list of synonyms
- [1] (http://blog.wired.com/wiredscience/2007/08/fungi-make-biod.html) Fungi Make Biodiesel Efficiently at Room Temperature

Eastern subterranean termite

From Wikipedia, the free encyclopedia
(Redirected from Reticulitermes flavipes)

Reticulitermes flavipes, the **eastern subterranean termite** is the most common termite found in North America.[1] These termites are the most economically important wood destroying insects in the United States and are classified as pests.[1] They feed on cellulose material such as the structural wood in buildings, wooden fixtures, paper, books and cotton. A mature colony can range from 20,000 workers to as high as 5 million workers and the queen of the colony lays 5,000 to 10,000 eggs per year to add to this total.[1]

Eastern subterranean termite

Scientific classification

Kingdom:	Animalia
Phylum:	Arthropoda
Class:	Insecta
Order:	Isoptera
Family:	Rhinotermitidae
Genus:	*Reticulitermes*
Species:	***R. flavipes***

Binomial name

Reticulitermes flavipes

(Kollar, 1837)

Contents

Distribution

The eastern subterranean termite is the most widely distributed termite found in the eastern United States. *R. flavipes* is commonly found in Southern Ontario, and is found in all the eastern states including Texas.[2]

Other termites found there are the dark southeastern subterranean termite (*Reticulitermes virginicus*) and the light southereastern subterranean termite (*Reticulitermes hageni*). These are less important economically (such as in damage to crops) because of their more limited range.[3]

Description

Eastern subterranean termites, like other social insects, share resources and divide labor based on a caste system.[1] They live in loosely associated societies called colonies which are composed of both males and females. The termites in the colony are generally organized into the worker caste, the soldier caste, and the reproductive caste.[1]

Worker caste

Workers are about 1/8 inch long and are blind, wingless, soft-bodied, creamy white to grayish-white with a round head. They make up the majority of the termites that actually eat the wood. They are sterile and forage for food and water, construct and repair shelter tubes, feed and groom other termites, care for eggs and young, and participate in colony defense.[3]

Soldier caste

Soldier termites are also wingless and resemble workers except that they have a large, rectangular, yellowish-brown head with long black mandibles. The soldiers' primary function is colony defense [1] and the mandibles are mainly used for crushing enemy ants which may invade the colony. Additionally, *R. flavipes* has a fontanelle (frontal gland pore) on the forehead which releases a sticky latex to ensnare enemy ants.[2] The soldier caste only makes up 1 to 2% of the entire colony. The soldiers are not capable of feeding themselves and rely on the worker termites to provide them with regurgitated food.[1]

Reproductive caste

These are the adult winged termites who have two pairs of long narrow wings of equal size, dark skin, and beaded antennae.[1] A nuptial flight takes place, mating occurs and they shed their wings. They are black and about one centimeter long, with grayish transparent wings. Neotenic reproductives are potential kings and queens of the colony, available as replacements if needed. They are generally yellow or mottled black and the abdomen of the female may be distended with developing eggs.[3]

Life cycle

R. flavipes are opportunistic, and a newly hatched termite can develop into any of a number of castes. At first, it becomes a worker termite and is most likely to remain one for its entire lifespan. Molting can change the worker into a pre-soldier and subsequently, a soldier. The soldier caste is a terminal stage which can no longer molt.[3]

R. flavipes also molts into nymphs, which are the precursors of winged adult termites called alates which are sexually mature. Nymphal termites are non terminal and can revert back to the worker stage. These reverted nymphs are called pseudergates. Nymphs and workers can also develop into secondary and tertiary neotenic reproductives respectively.[3]

Behavior

Because termites are social insects, they share a lot of their tasks. This can be seen through the caste system, where different castes take on different responsibilities for the good of the whole colony. *R. flavipes* cooperate in the rearing of young and also share their resources with the nest.[3]

Swarming is the sudden, dramatic appearance of *R. flavipes* alates in the daytime from February to April. After this behavior male and female alates lose their wings, pair up, and form new colonies.[3]

R. flavipes is mobile throughout its life and no permanent central nest area exists. Therefore all termite castes can be found in any of the different sites occupied by a colony. Their activity is determined by food, moisture and temperature, and movement is usually driven by one of these necessities. Termites feed on anything made of or containing cellulose, but can tunnel into non-cellulose containing material to gain access to their destination. This behavior can be destructive to human activities.[3]

Human impact

Along with *Reticulitermes virginica*, *R. flavipes* is responsible for 80% of the $2.2 billion spent annually in the United States on termite control.[4] Termites feed on wood cellulose, meaning that their presence in human made structures often goes unnoticed for lengthy periods of time. A termite infested timber will appear structurally sound from the outside, while inside it will have a honeycombed appearance. To detect the presence of *R. flavipes* the observer can test the integrity of the wood by tapping it with a screwdriver. If present, *R. flavipes* is found at, near or below ground level. Trim work, sub flooring, flooring, and the structural timbers are the areas of a building most susceptible to termite damage. The Eastern subterranean termite is considered a serious economic timber pest and it is estimated that in high activity areas more than 1 in 5 homes have been or will be attacked.[2]

Termite control methods include: physical barriers, chemical treatments, and physical treatments (such as heat, freezing, electrocution and microwave irradiation).[5]

Structural damage to buildings is not *R. flavipes'* only impact on humans. Termites also play a critical role in the decomposition of organic matter in natural communities. Without termites, the accumulation of dead organic matter on the forest floor would become detrimental to integrity of that forest. The benefits provided by *R. flavipes* in terms of their contribution to environmental regulation may far outweigh the disadvantages they pose.

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External links

- Urban Entomology Program [1]

External identifiers for *Reticulitermes flavipes*

EOL 469521 (http://www.eol.org/pages/469521)

Also found in: Wikispecies (//species.wikimedia.org/wiki/Reticulitermes_flavipes)

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- Biology of Subterranean Termites in the Eastern United States [2] (http://ohioline.osu.edu/b1209/index.html)
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