

Risk Classification of Organisms: Pathogenicity classification of parasites

Status December 2021

COGEM advice CGM/211209-01

Dutch Regulations Genetically Modified Organisms

In the Decree on Genetically Modified Organisms (GMO Decree) and its accompanying more detailed Regulations (GMO Regulations) genetically modified micro-organisms are grouped in four pathogenicity classes, ranging from the lowest pathogenicity Class 1 to the highest Class 4.¹ The pathogenicity classifications are used to determine the containment level for working with GMOs.

A micro-organism of Class 1 should at least comply with one of the following conditions:

- a) the micro-organism does not belong to a species of which representatives are known to be pathogenic for humans, animals or plants,
- b) the micro-organism has a long history of safe use under conditions without specific containment measures,
- c) the micro-organism belongs to a species that includes representatives of class 2, 3 or 4, but the particular strain does not contain genetic material that is responsible for the virulence,
- d) the micro-organism has been shown to be non-virulent through adequate tests.

A micro-organism is grouped in Class 2 when it can cause a disease in humans or animals whereby it is unlikely to spread within the population while an effective prophylaxis, treatment or control strategy exists, as well as an organism that can cause a disease in plants.

A micro-organism is grouped in Class 3 when it can cause a serious disease in humans or animals whereby it is likely to spread within the population while an effective prophylaxis, treatment or control strategy exists.

A micro-organism is grouped in Class 4 when it can cause a very serious disease in humans or animals whereby it is likely to spread within the population while no effective prophylaxis, treatment or control strategy exists.

Pathogenicity classification of parasites

The Netherlands Commission on Genetic Modification (COGEM) advises the Dutch government (amongst others) on the classification in risk groups (classes) of organisms according to the risk they pose to human health and the environment. These classifications are written in Dutch and are therefore only published on the Dutch part of the COGEM website.

1. Ministerie van Infrastructuur en Milieu. Regeling genetisch gemodificeerde organismen milieubeheer 2013. <https://wetten.overheid.nl/BWBR0035072/2021-04-01> [In Dutch]

In order to inform other countries and/or organisations about the classification of organisms by COGEM, the most recent classification list of parasites has been translated. The current update includes 4 species of parasites that have been advised on by COGEM between January 2012 and December 2021. The parasites have been categorized by single celled species, parasitic roundworms and flatworms and parasitic arthropods (ectoparasites).

1 **Table 1.** Pathogenicity class of different parasite species.

Genus/species	Family*	Phylum*	PG	Alternative name or remarks
<i>Single cell parasites</i>				
<i>Acanthamoeba castellanii</i>	<i>Acanthamoebidae</i>	<i>Discosea</i> (supergroup Amoebozoa)	2	
<i>Babesia</i> spp.	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Babesia bigemina</i>	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Babesia bovis</i>	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Babesia canis</i>	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Babesia divergens</i>	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Babesia microti</i>	<i>Babesiidae</i>	<i>Apicomplexa</i>	2	
<i>Cryptosporidium</i> spp.	<i>Cryptosporidiidae</i>	<i>Apicomplexa</i>	2	
<i>Cryptosporidium parvum</i>	<i>Cryptosporidiidae</i>	<i>Apicomplexa</i>	2	
<i>Eimeria</i> spp.	<i>Eimeriidae</i>	<i>Apicomplexa</i>	2 ^A	
<i>Entamoeba histolytica</i>	<i>Entamoebidae</i>	<i>Evosea</i> (supergroup Amoebozoa)	2	
<i>Giardia</i> spp.	<i>Hexamitidae</i>	<i>Fornicata</i>	2	
<i>Leishmania infantum</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2	Possible transmission via puncture or cutting accidents, or via mucous membranes. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.
<i>Leishmania major</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2	Possible transmission via puncture or cutting accidents, or via mucous membranes. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.

Genus/species	Family*	Phylum*	PG	Alternative name or remarks
<i>Leishmania mexicana</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2	Possible transmission via puncture or cutting accidents, or via mucous membranes. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.
<i>Leishmania tarentolae</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2	Possible transmission via puncture or cutting accidents, or via mucous membranes. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps..
<i>Leishmania tropica</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2	Possible transmission via puncture or cutting accidents, or via mucous membranes. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.
<i>Neospora spp.</i>	<i>Sarcocystidae</i>	<i>Apicomplexa</i>	2 ^A	
<i>Neospora caninum</i>	<i>Sarcocystidae</i>	<i>Apicomplexa</i>	2 ^A	
<i>Plasmodium spp.</i> [#] (m.u.v. van <i>Plasmodium falciparum</i>)	<i>Plasmodiidae</i>	<i>Apicomplexa</i>	2	Possible transmission via puncture or cutting accidents. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as limiting the use of sharps.
<i>Plasmodium falciparum</i> [#]	<i>Plasmodiidae</i>	<i>Apicomplexa</i>	3	Possible transmission via puncture or cutting accidents. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as limiting the use of sharps.
<i>Theileria spp.</i>	<i>Theileriidae</i>	<i>Apicomplexa</i>	2 ^A	
<i>Theileria annulata</i>	<i>Theileriidae</i>	<i>Apicomplexa</i>	2 ^A	
<i>Theileria equi</i>	<i>Theileriidae</i>	<i>Apicomplexa</i>	2 ^A	Previously known as <i>Babesia equi</i> .

Genus/species	Family*	Phylum*	PG	Alternative name or remarks
<i>Toxoplasma gondii</i> #	<i>Sarcocystidae</i>	<i>Apicomplexa</i>	2	Possible transmission via puncture or cutting accidents or eye mucous membranes. In order to protect the employee, COGEM recommends that additional precautions and measures be taken during GMO activities, such as wearing protective glasses and limiting the use of sharps. Because of possible risks of infection during pregnancy, she advises to exclude pregnant women from working with GM <i>T. gondii</i> .
<i>Trypanosoma brucei</i> ssp. <i>brucei</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2 ^A	
<i>Trypanosoma carassii</i>	<i>Trypanosomatidae</i>	<i>Euglenozoa</i>	2 ^A	
<i>Trypanoplasma borreli</i>	-	<i>Euglenozoa</i>	2 ^A	
Parasitic worms				
<i>Cooperia</i> spp.	<i>Cooperiidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2 ^A	
<i>Cooperia curticei</i>	<i>Cooperiidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2 ^A	
<i>Cooperia oncophora</i>	<i>Cooperiidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2 ^A	
<i>Dictyocaulus</i> spp.	<i>Dictyocaulidae</i>	<i>Nematoda</i>	2 ^A	
<i>Dictyocaulus viviparus</i>	<i>Dictyocaulidae</i>	<i>Nematoda</i>	2 ^A	
<i>Echinococcus granulosus</i>	<i>Taeniidae</i>	<i>Platyhelminthes</i>	3	The infectivity depends on the life-stage of the <i>E. granulosus</i> . Downscaling to a lower containment level is possible when working with metacestodes. Transmission can occur during the metacestode stage via puncture or cutting accidents or via the eye mucosa. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.

Genus/species	Family*	Phylum*	PG	Alternative name or remarks
<i>Echinococcus multilocularis</i>	<i>Taeniidae</i>	<i>Platyhelminthes</i>	3	The infectivity depends on the life-stage of the <i>E. multilocularis</i> . Downscaling to a lower containment level is possible when working with metacestodes. Transmission can occur during the metacestode stage via puncture or cutting accidents or via the eye mucosa. In order to protect the employee, COGEM recommends that additional precautions are taken during GMO activities, such as wearing protective glasses and limiting the use of sharps.
<i>Fasciola hepatica</i>	<i>Fasciolidae</i>	<i>Platyhelminthes</i>	2	
<i>Haemonchus contortus</i>	<i>Haemonchidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2	
<i>Meloidogyne incognita</i>	<i>Meloidogynidae</i>	<i>Nematoda</i>	2 ^P	
<i>Ostertagia ostertagi</i>	<i>Haemonchidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2 ^A	
<i>Schistosoma mansoni</i>	<i>Schistosomatidae</i>	<i>Platyhelminthes</i>	2	In the developmental stage 'cercaria', infection can occur through the skin. In order to protect the employee, COGEM advises that additional precautions are taken during activities with GM <i>S. mansoni</i> 'cercariae', such as using gloves that cover the sleeve.
<i>Strongyloides stercoralis</i>	<i>Strongyloididae</i>	<i>Nematoda</i>	2	Transmission of <i>S. stercoralis</i> larvae can occur through the skin or, when working with large quantities of larvae (e.g., in a culture), through the conjunctiva. In order to protect the employee, COGEM advises that additional precautions are taken during work with GM <i>S. stercoralis</i> larvae, such as using gloves that cover the sleeve and wearing protective glasses.
<i>Teladorsagia circumcincta</i>	<i>Haemonchidae</i> (superfamily <i>Trichostrongyloidea</i>)	<i>Nematoda</i>	2 ^A	Previously known as <i>Ostertagia circumcincta</i> .
<i>Toxocara</i> spp.	<i>Toxocaridae</i>	<i>Nematoda</i>	2	
<i>Trichinella</i> spp.	<i>Trichinellidae</i>	<i>Nematoda</i>	2	

Genus/species	Family*	Phylum*	PG	Alternative name or remarks
<i>Trichinella spiralis</i>	<i>Trichinellidae</i>	<i>Nematoda</i>	2	
<i>Trichostrongylus</i> spp.	<i>Trichostrongylidae</i>	<i>Nematoda</i>	2 ^A	
Parasitic arthropods				
<i>Ixodes</i> spp.	<i>Ixodidae</i>	<i>Arthropoda</i>	2	
<i>Ixodes ricinus</i>	<i>Ixodidae</i>	<i>Arthropoda</i>	2	
<i>Rhipicephalus microplus</i>	<i>Ixodidae</i>	<i>Arthropoda</i>	2	Previously known as <i>Boophilus microplus</i> .

* According to the NCBI Taxonomy browser and Eyclopedia of Life, combined with a literature search when results are inconsistent. PG – pathogenicity class, A – animal pathogen, P – plant pathogen, spp. (species pluralis) – multiple species, ssp - subspecies