# RISK ASSESSMENT AND RISK MANAGEMENT PLAN FOR LICENCE FOR INTENTIONAL RELEASE OF GM OILSEED POPPY INTO THE ENVIRONMENT:

**Application No. DIR 018/2002**

## SUMMARY INFORMATION

**September 2002**

<table>
<thead>
<tr>
<th><strong>Project Title:</strong></th>
<th>Field assessment of alkaloids in modified poppy</th>
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<tbody>
<tr>
<td><strong>Applicant:</strong></td>
<td>CSIRO</td>
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<td></td>
<td>PO Box 1600</td>
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<td></td>
<td>Canberra ACT 2601</td>
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<td><strong>Common name of the parent organism:</strong></td>
<td>Oilseed poppy</td>
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<td><strong>Scientific name of the parent organism:</strong></td>
<td><em>Papaver somniferum</em></td>
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<td><strong>Modified trait(s):</strong></td>
<td>Modification of the alkaloid production pathway</td>
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<td><strong>Identity of the gene(s) responsible for the modified trait(s):</strong></td>
<td>There are a total of eight (8) types of genetically modified oilseed poppies. The modifications are intended to vary alkaloid production by altering the expression of one of five plant genes* that produce proteins that function at different steps in the alkaloid synthesis pathway. All of the GM poppies contain a selectable marker gene \textit{npt} II from the bacterium \textit{Escherichia coli} that confers antibiotic resistance. *note that some details of the gene constructs, including the identity of the alkaloid genes and their regulatory sequences, have been declared as Confidential Commercial Information (CCI) under section 185 of the \textit{Gene Technology Act 2000}</td>
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<td><strong>Location:</strong></td>
<td>Meander Valley municipality (Tasmania)</td>
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<tr>
<td><strong>Trial Size:</strong></td>
<td>A maximum of 0.064 hectares on one site</td>
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<td><strong>Time of Release:</strong></td>
<td>November 2002</td>
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Introduction

The Gene Technology Regulator (the Regulator) has made a decision to issue a licence in respect of the application (DIR 018/2002) from CSIRO. The licence is for a limited and controlled release of GM oilseed poppy in Tasmania.

The decision was made after extensive consultation on the risk assessment and risk management plan for this application with the public, State and Territory governments, relevant Commonwealth agencies, the Gene Technology Technical Advisory Committee, the Federal Environment Minister and relevant local councils, as required by the Gene Technology Act 2000 (the Act).

Some details of the gene construct, including the identity of the alkaloid pathway genes, and the identity and origins of the regulatory sequences have been declared as Confidential Commercial Information (CCI) under section 185 of the Act. However, the CCI information was available to the various expert groups who were consulted on the preparation of the Risk Assessment and Risk Management Plan (RARMP).

The organism to be genetically modified is oilseed poppy (Papaver somniferum subsp. somniferum). A total of eight types of genetically modified oilseed poppy will be trialed in order to examine the effect of the modifications on alkaloid production under field conditions.

The modifications are intended to vary alkaloid production by altering the expression of one of five plant genes that produce proteins that function at different steps in the alkaloid synthesis pathway.

Four of the five modified alkaloid synthesis genes are derived from oilseed poppy, while the fifth is from the related Californian poppy (Eschscholzia californica). The expression of each of the introduced genes is under the control of one of two viral promoters, and a termination or “stop” sequence that ends transcription of the introduced genes.

All of the modified poppies also contain the selectable marker gene nptII from the bacterium Escherichia coli. The nptII gene encodes the enzyme neomycin phosphotransferase II (NPTII which confers resistance to the aminoglycoside antibiotics ribostamycin, paromomycin, kanamycin, neomycin, and gentamicins A and B. The nptII gene also contains an intron derived from the catalase-1 gene of the castor bean, Ricinus communis. The expression of the nptII gene is under the control of the cauliflower mosaic virus (CaMV) 35S promoter and termination sequences.

CSIRO will carry out a limited and controlled field release at one site in the Meander Valley shire, Tasmania. The GM oilseed poppy plantings comprise an area of 0.064 ha. The GM poppies will be surrounded by a 10 metre pollen trap of non-GM poppies, making up a total trial site area of 0.21ha. None of the oilseed poppy plants from the release or their by-products will be used for human or animal feed, or therapeutics, or for any other commercial use.

It should be noted that, even though a licence for the limited and controlled release has been issued by the Regulator, the applicant will also require approval from the Tasmanian State Government under the Plant Quarantine Act 1997 (Tasmania).

Summary information about the application (minus information that has been declared Commercial Confidential by the Regulator), the genetically modified organisms, and the regulatory system established by the Act is available in the document, ‘Summary information on application number DIR 018/2002’. More detailed information is available in the risk assessment and risk management plan (RARMP) that has been prepared in accordance with the requirements of the Act. These documents are available from the Office of the Gene Technology Regulator or from the Office’s web site (see contact details below).
This document summarises the conclusions of the risk assessment process and the risk management plan. It also includes a summary of the licence conditions developed to manage the risks identified by the risk assessment and ensure that the management plan is implemented.

**Summary of risk assessment**

A number of possible hazards that could arise as a direct result of the genetic modification of oilseed poppy were considered. They include:

- whether GM oilseed poppies may be harmful to other organisms, including humans, through potential toxicity or allergenicity;
- whether GM oilseed poppies may be harmful to the environment through weediness or increased potential for weediness; and
- whether the genes introduced into poppies can transfer to non-GM oilseed poppies, naturalised *Papaver* species, or to other organisms.

The risks that may occur should these hazards be realised were considered. It is concluded that no substantive additional risks would be posed to public health and safety or to the environment by the release as a result of the genetic modification of GM oilseed poppy, compared to those posed by non-GM oilseed poppy because:

- GM oilseed poppies are not likely to prove more allergenic or toxic to humans or other organisms than non-GM oilseed poppy.
- The risk of GM oilseed poppies in establishing as a weed is low and further reduced by the tight controls imposed for the release; and
- The likelihood of transfer of the introduced genes to other organisms is low, but even if such a transfer occurred, it would be unlikely to pose any hazard to human health and safety or the environment.

**Risk of toxicity or allergenicity**

It should be noted that:

- non-GM oilseed poppy has been grown for centuries for use in pharmaceutical and medical applications;
- the level of alkaloids has been increased over 3-fold in non-GM oilseed poppy over the last 30 years through conventional breeding;
- this increase in alkaloid level and resultant toxicity has not resulted in any adverse consequences; and
- there have been no reports of adverse impacts from previous field trials of GM oilseed poppies under the former voluntary system.

If ingested, conventional oilseed poppy is known to be moderately toxic to animals and humans due to its morphinan alkaloid content. However, it is considered that the likelihood of adverse toxic or allergenic impacts on humans, or other species, as a result of possible enhanced toxicity or allergenicity of the GM oilseed poppies in the release is very low.
The exposure of humans and animals to the GM poppies will be very limited. All production of oilseed poppies in Tasmania is tightly controlled and monitored by the Poppy Advisory and Control Board under the Poisons Act 1971 (Tasmania). Unauthorised access to poppy fields is prohibited, hence exposure of people to the GM oilseed poppy and the introduced proteins is likely to be minimal. For workers at the site the Regulator has included in the licence conditions the requirement for personal protection equipment to be worn when entering the location or pollen trap during the flowering of the GMO.

There is a very small risk of exposure to animals including birds, as the licence conditions require the field trial area to be fenced to exclude small and larger animals and enclosed by bird netting.

The applicant does not intend to use the GM poppies or their by-products for animal or human food, or for therapeutics, or for any other commercial use. In addition, the Regulator has imposed licence conditions to restrict the use of material from the release. On an agricultural scale, the scale of the release is relatively small (0.064 ha), and any environmental impacts due to toxicity are likely to be localised to the specific release site and therefore, are manageable.

**Risk of weediness**

The risk of the GM oilseed poppy spreading into the environment and causing harm to the environment is very low and not likely to be greater than for non-GM oilseed poppy. The reasons for these conclusions are that the introduced genes in oilseed poppy are not likely to increase the weedy potential of the plants. Oilseed poppy is not a weed and is grown as a restricted crop in Australia. The genetic modifications are for genes involved in the production of secondary metabolites or alkaloids and none of these genes are known to have an effect on the weedy potential of poppy.

Volunteer poppies that may grow after harvest of the GM poppies are easy to detect and remove. Furthermore, licence conditions have been imposed to manage this risk (see below, Summary of risk management plan).

**Risk of gene transfer**

The likelihood of gene transfer from the GM oilseed poppies to non-GM oilseed poppy is very low. Data from studies conducted in Australia indicate that the rate of outcrossing in *P. somniferum* is low and has been estimated to be less than 2% at distances over 1m. The risk of gene transfer from *P. somniferum* to related species is considered to be very low. There are no reports of hybridisation through open pollination between *P. somniferum* and related species, and the only reports of successful hybridisation events are from hand pollination studies. The risk of gene transfer to other plant species including Australian native species, or to animals, or to microorganisms is considered to be negligible. Moreover, the licence conditions will further minimise the risk of gene transfer (see below, Summary of risk management plan). The conclusions with respect to each transferred gene sequence are as follows:

**Alkaloid pathway enzyme genes**

A potential risk from the transfer of the alkaloid production pathway genes to other poppies through outcrossing might be increased toxicity as a result of increased alkaloid content. However gene transfer is not likely to confer any selective or competitive advantage especially as oilseed poppies are managed cultigens in Australia. Gene transfer to related species would be very unlikely to result in increased toxicity because the introduced gene would encode only one step of the multi-step alkaloid production pathway. Thus production of alkaloids or enhanced production of alkaloids is unlikely to be conferred.
Antibiotic resistance gene

The nptII gene is prevalent in naturally occurring bacteria found in soil and in animal and human digestive systems and therefore antibiotic resistance is widespread among soil bacteria. There would be no adverse consequences even if transfer of the gene occurred. Of the aminoglycoside antibiotics that the nptII gene confers resistance to, only gentamicin and neomycin are currently used in human therapy and veterinary medicine. Both are infrequently used, neither is unique for any use, and oral administration of either of them is rare. Furthermore, nptII only confers resistance to gentamicins A and B, whereas gentamicins used in human therapeutics contain primarily gentamicins C₁, C₁a, C₂, and C₂a. The nptII gene would not confer any selective advantage on plants as antibiotics are not used to control plants and are not a limiting factor for their spread or persistence. Even in the extremely unlikely event that the nptII gene was transferred to a bacterium, the presence of the cat-1 intron would prevent the expression of a functional NPTII protein.

Viral regulatory sequences

The GM poppies contain some regulatory sequences derived from viral plant pathogens. These sequences represent a small portion of the pathogens’ genome, and are not in themselves infectious or pathogenic. The viruses in question and the regulatory sequences used in the genetically modified oilseed poppy are already present in the environment and in the human diet.

The likelihood of horizontal gene transfer from plants to microorganisms, including viruses, or to animals and humans is negligible, and it is considered that transfer of the regulatory sequences would in any case be unlikely to pose a hazard to human health and safety or to the environment.

Summary of risk management plan

Risk of toxicity or allergenicity

None of the GM poppies or their by-products from this release are intended for use in human food, animal feed, therapeutics or for any other commercial purpose, and conditions have been included in the licence to restrict the use of the GM material produced during the trial. The management strategies included in the licence conditions are considered adequate to manage any potential risks of toxicity and allergenicity (see below, Risk management actions)

Risks of weediness or gene transfer

It has been concluded that the risks relating to weediness or gene transfer are low. Nevertheless, the risks will be further reduced by implementing management strategies to minimise the spread and persistence of GM oilseed poppy, or the modified genetic material, in the environment.

Risk management actions

The licence includes a number of specific conditions relating to risk management. The conditions include requirements to:

- restrict access to the release site to authorised personnel only;
- require authorised personnel to wear protective clothing when handling GM oilseed poppies during the period of flowering;
- cover the release site with a bird net and and surround it with a fence to prevent small and large animals, and birds from accessing GM oilseed poppies;
- prohibit the use of the GM oilseed poppies or their by-products in human food, animal food, therapeutics, or for any other commercial purpose;
- separate the GM oilseed poppies from all conventional poppy crops by at least 500 m;
- surround the GM poppies with a 10 m pollen trap comprising non-GM oilseed poppy;
monitor a 100m zone around the pollen trap and location and remove any oilseed poppies and related species during the growing of the GMO;

harvest the indehiscent (i.e. non-splitting) seed capsules by hand;

after harvest, destroy any viable material not required for analysis and destroy the remaining material at the release site;

after harvest, lightly cultivate and irrigate the release site to encourage germination of any seed, monitor the release site on a monthly basis for a period of at least three years, and destroy any poppy plants (volunteers) that germinate or regrow;

after harvest, prohibit sowing oilseed poppy at the site for a period of at least three years; and

The applicant is also required to develop and implement a research program that addresses questions relating to gene flow and environmental impacts of GM poppies.

**Monitoring and enforcement of compliance by the OGTR**

It should be noted that as well as imposing licence conditions the Regulator has additional options for risk management. The Regulator has the legislative capacity to enforce compliance with licence conditions and, indeed, to direct a licence holder to take any steps the Regulator deems necessary to protect the health and safety of people or the environment. The OGTR also independently monitors trials it has authorised. At least 20% of all trial sites will be monitored on a rolling basis each year, to determine whether licence holders are complying with the licence conditions, or whether there are any unforseen problems that have not been reported by the licensee.

In identifying when to undertake routine monitoring visits, sites are selected on the basis of a risk profile. In assembling a risk profile of a site, a number of factors are taken into account, including the type of GMO(s) and biological, season/geographical/ecological risk factors for both current and post-harvest field trial sites. For example, the critical periods for monitoring to occur in respect of GM field trials are when the trial is at its ‘higher risk’ points (i.e. when there may be a higher risk to the health and safety of people and/or the environment), for example during flowering of a crop, when the possibility of outcrossing is highest.

**Contact details**

Copies of the complete risk assessment and risk management plan, as well as this summary information, can be obtained from the OGTR at the address below or from the Office’s website. Summary and full copies of the licence application are also available from the Office. Please quote application number DIR 018/2002.

**The Office of the Gene Technology Regulator**

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