

Assessing and monitoring the
environmental impact of late blight
resistant GM potatoes
(2012 – 2015)



What are we doing?

On July 27th 2012, the Environmental Protection Agency (EPA) gave consent to Teagasc to start its field-based research study of a GM potato variety, which in separate European studies has displayed durable resistance to potato late blight disease. The research has three primary goals:

- Quantify the impact of the GM potato on soil microbes (e.g. bacteria, fungi, worms etc...)
- Evaluate the application of a novel Integrated Pest Management Strategy to control blight disease.
- Research the impact of the GM potato on *Phytophthora infestans*, the organism that causes blight disease itself

What are we not doing?

We are not producing GM potatoes for production or commercial purposes. Our role is to investigate the potential negative and/or positive impacts of GM technology in regard to this specific GM variety and then inform stakeholders and the general public as to conclusions drawn based on an Irish-specific research study.

Why are we carrying out this study?

The potato sector faces significant challenges in the next 10 years. Increased EU legislation will curtail the amount and type of crop protection products that farmers can use. This will be a major issue for Irish potato growers, as conventional potatoes receive at least 15 sprays per season.

For over 30 years, we have monitored Irish blight populations. In the last 5 years we have recorded the emergence of more

aggressive strains of blight (termed 'Blue 13' and 'Pink 6'), some of which exhibit levels of fungicide resistance. There are no varieties available to commercial farmers with complete resistance to late blight and which meet post-harvest processing requirements.

GM technology is a laboratory based technique that accelerates the breeding process. For example, it typically takes ~14 years to breed a new variety using traditional practises; using GM technology a new variety could be generated in 18 weeks and ready for market in 4-5 years. But while it can generate varieties quicker, we need to assess and monitor the impact such varieties could have on the Irish agri-environment. We will not rely on research conducted by the opponents or proponents of GM technology, for while it may be scientifically sound, it cannot claim to be unbiased.

By acting in this manner Teagasc is addressing the GM question in a responsible and contained manner that will not impact on existing crop systems and will not compromise Ireland's world leading food export market.

Who are we collaborating with?

The current study is funded through the European Commission's 7th Framework as part of the larger EU funded 'AMIGA' (Assessing and Monitoring the Impacts of Genetically modified plants on Agro-ecosystems) project, which has 22 partners from Research Centres, Universities and State Agencies across 15 EU countries (www.amigaproject.eu). There is no industry involvement in the Teagasc study. More information on AMIGA is available at the end of this briefing document.

Where did the GM potato originate from?

The GM variety we are using was generated through the Dutch 'DurPh' programme (<http://www.durph.wur.nl/UK/>), based at Wageningen University. The potato has been made available to Teagasc via a standard material transfer agreement. As such we can, and will fully disseminate our research findings, in whole, to the Irish public upon completion of our study. There is no 'commercial contract' in place at the end of this study as Teagasc is not in the business of commercialising or promoting GM crops.

What makes the GM potato resistant to blight?

We are currently studying a GM line of the potato variety Desiree; a popular variety on the continent but a variety that is highly susceptible to blight disease. At Wageningen University, researchers have successfully isolated several 'R genes' (resistance genes) from species of wild potato, that originate in Central and South America.

Using GM techniques they took one R gene (vnt 1.1) from the wild species *Solanum venturii* and transferred it into Desiree, thereby delivering strong late blight resistance to a previously susceptible commercial variety. The performance of this GM Desiree variety has been demonstrated in several field studies in the Netherlands.



Wild potato species

Solanum venturii

How did we know this GM potato variety would perform in Ireland?

We didn't. That is why after receiving the license from the EPA in 2012, we completed a small field study with 24 GM and 24 non-GM plants at Oak Park. This confirmed that the GM Desiree (and the vnt1.1 R gene) could perform in Ireland against Irish blight (see below).



However, the 2012 study was a small scale evaluation, completed in a single year. To ensure statistical validity, the evaluations must be completed on a larger scale and across 3 years; the first of which will commence in summer 2013.

What will be included in the 2013 field study?

A total of 5274 plants will be included in the 2013 study. This will be split across three potato varieties:

- GM Desiree (1758 plants)
- Non-GM Desiree (1758 plants)
- Sarpo Mira (1758 plants)

Whereas the GM Desiree is equipped with a single wild potato R gene, a recent research study indicates that Sarpo Mira, a variety favoured by organic growers, may contain up to 5 wild potato R genes. The blight resistance of Sarpo Mira is well known, but the variety's eating and processing qualities are not strong. For this study, Sarpo Mira is being included so that we can determine how Irish blight strains respond to a separate resistant variety.

What research will be completed in 2013?

When conditions are favourable, the 2013 study will be planted at Oak Park (see site plan in Appendix 1). During the growing season, we will:

- Take soil samples from each potato variety to evaluate microbial diversity through the growing season. Specifically, we want to see if there are fluctuations in microbial diversity between each variety in response to the different treatments and if so, what does this mean.
- Compare the genetic diversity of blight strains that are isolated from the study during the growing season. We will focus on a certain blight gene that has the potential to 'respond' to the R gene in the GM variety. We want to know if that blight gene will change in those blight strains that are exposed to the GM variety over the course of the season
- Evaluate the impact of an Integrated Pest Management Strategy to control blight across the study. This will utilise a decision support system to monitor environmental conditions optimum for the spread of blight.

In addition, AMIGA partners from Germany and the Netherlands will be using the Oak Park site to determine whether the GM planting has a negative/positive impact on insects and bumblebees.

It is important to note that all of the above will be completed in parallel at the sister site at Wageningen, the Netherlands. This is an important part of the AMIGA project: the completion of parallel studies across different geographic locations to determine if identified effects are regional specific.

Will the results be communicated to the public?

Yes. At the end of the 3 year field programme the results will be sent for independent scientific peer review. If they are deemed suitable for scientific publication, the results will be disseminated to the public in a non-scientific manner.

From the onset of this project, we have committed to an active programme of engagement with community groups, stakeholders and the general public through print, radio, TV and online media.

In 2012, we participated in 48 dissemination/communication events with local, national and international media outlets and also through public debates. It is our intention to continue this level of interaction through 2013 and for the duration of the project, in order to address the knowledge deficit that currently exists in the public domain in regards to the challenges facing the potato sector and the options that may be available.

Furthermore, the updating of our website www.gmoInfo.ie will shortly be completed and this will contain live updates on progress of the field study during the growing season.

Additional clarification is available in Appendix 2, which contains an FAQ of the current study as published in the Farmers Journal (March 2012).

If you require further information contact:

Dr. Ewen Mullins

Senior Research Officer,

Teagasc, Dept. Crop Science,

Oak Park, Carlow

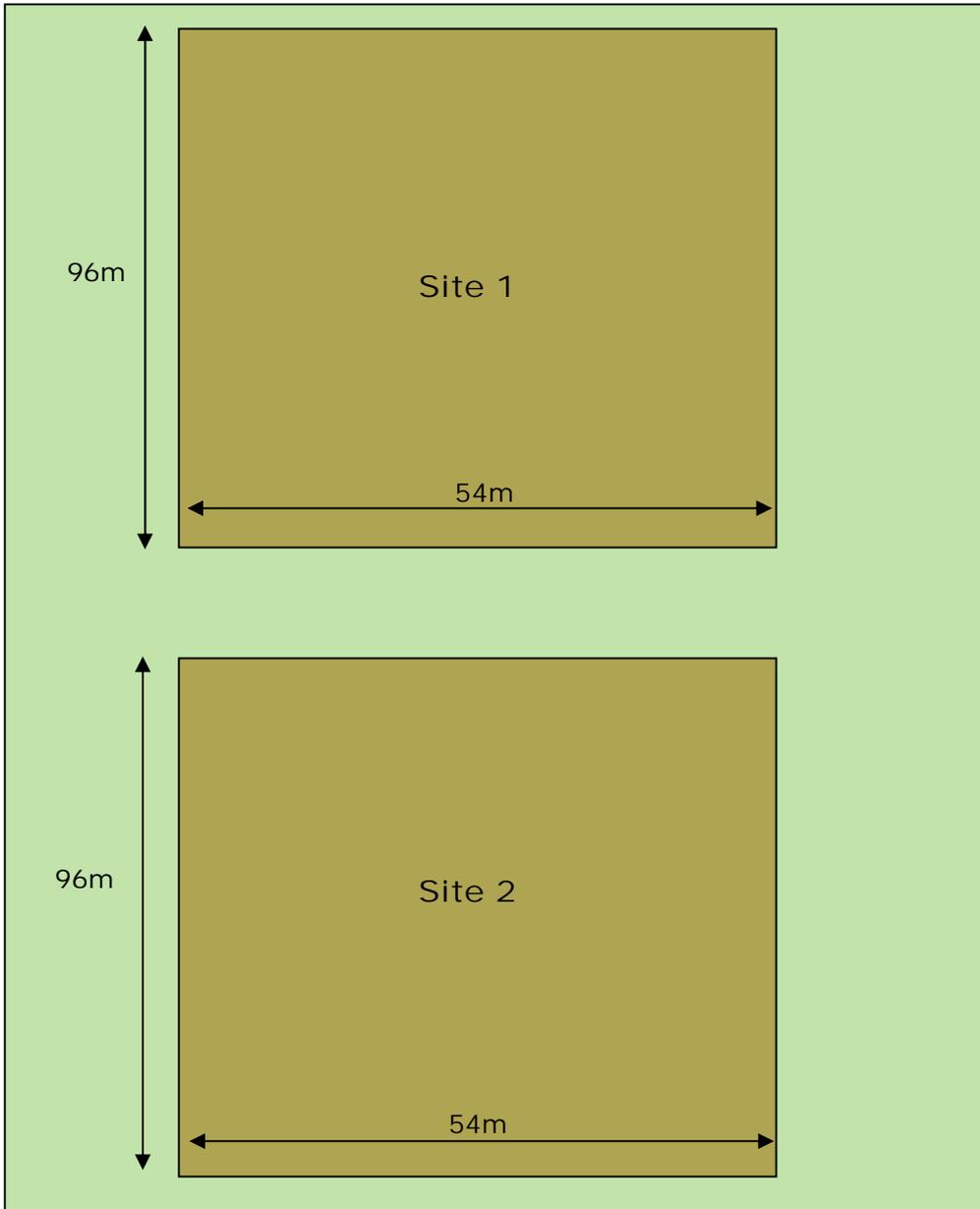
ewen.mullins@teagasc.ie

059 9170298 / 087 2924555

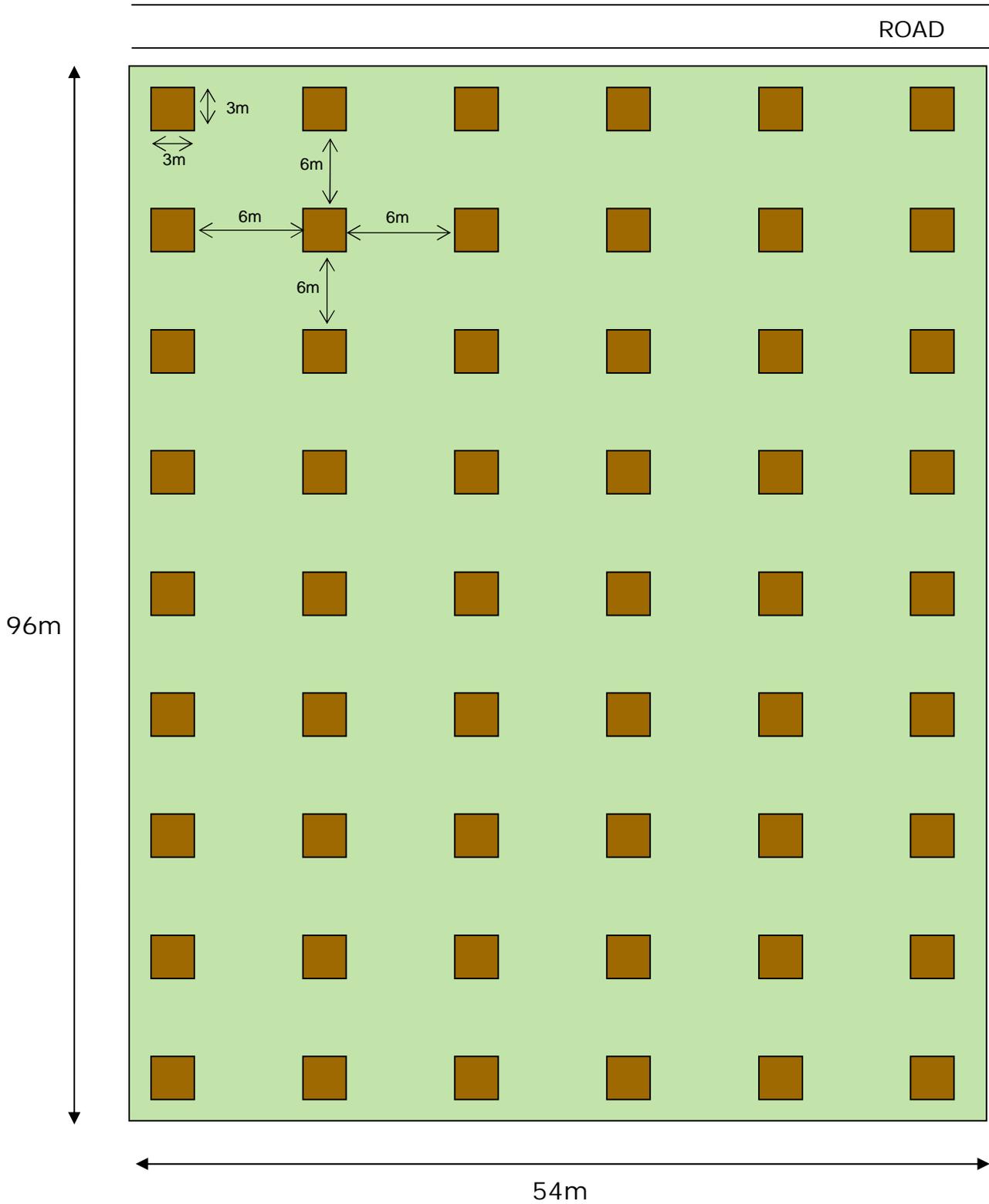
APPENDIX 1

Field Plan for 2013

ROAD



Individual site plan (1 of 2)



- 48 plots (3m x 3m) across each site

APPENDIX 2

Frequently asked questions in regards to proposed GM potato study, as published in the Farmers Journal (March 2012)

As the potato cv. Desiree will be given the DNA of a wild potato variety – why can this not be done by conventional breeding methods?

It can but there are two problems. First of all it takes considerably longer. It took potato breeders 49 years to develop current varieties containing genes from wild potato species. Fortunately, significant advances have been made in potato breeding to the point where this could theoretically be reduced to 17 years. Secondly, and the biggest problem is what we call 'linkage drag', which occurs when you try and breed in new traits from wild potato species. Linkage drag means that while you get for example improved disease resistance in your new variety its overall agronomic performance for other traits can be reduced

What is the herbicide that you will be using to kill the remnants of the field trials?

It will be generic glyphosate, which is readily available in garden centres and hardware shops and used in conventional tillage crops all over the country.

40m sounds like a very low buffer zone to protect the Irish non-GM crops.

On the contrary, it is almost double what we have observed as being necessary in field studies at Oak Park. Over 3 successive years (2008 – 2010), the average pollen dispersion for cv. Desiree was 11m. In a separate study in 2006, which was designed to maximise pollen transfer in a 'worst case scenario', we observed berry formation (indicating pollen spread) at 21m. Yet, only 2.8% of the berries formed contained viable seed. However, taking this single result into account we have suggested 40m as a minimum distance. Based on the cropping rotations at Oak Park, it is likely that the distance will exceed 100m.

With most of the EU consumers not wanting GM on their tables, and farmers not wanting to grow it, why is it so important to waste taxpayers' money on this?

We are focussed on the Irish consumer and the Irish tillage sector. We have

consistently been asked through our discussion groups, farmer meetings, public lectures etc... to produce Irish-specific information on the environmental impacts, so that people can make an informed choice. For over 10 years now we have witnessed the intractable GM debate between the anti- and pro-GM sides. There is a clear need for scientifically sound, Irish-specific information on this matter and that is what we propose to deliver.

Separately, it is important to note that the potato cultivar that we have sought a license to study is a 'cisgenic' line. Cisgenic refers to the transfer of genes within a genus (e.g. from a wild potato to a commercial potato), but because of the method used to transfer the genes they are still covered by GM legislation. This contrasts with the traditional understanding of GM, which is transgenic. In this case, genes are taken from one genus and transferred into any other (e.g. transferring a gene from a fish into a plant). Significantly, in the most recent survey of European consumers it was reported that while only 36% of Irish people surveyed would accept a transgenic variety, 61% would accept a cisgenic variety.

Late blight resistant potatoes are around already, through conventional breeding methods, without the need for bacterial infection (GM). There seems little point to add new varieties.

Quite the opposite. The potato sector faces significant challenges in the next 10 years. Increased EU legislation will curtail the amount and type of crop protection products that farmers can use. As conventional potatoes get sprayed up to 15 times per growing season to preserve the crop, this will be a major issue for Irish potato growers. In addition, we have monitored Irish blight populations for over 30 years and in the last 4 years we have recorded the emergence of highly aggressive strains of blight disease that are also exhibiting levels of fungicide resistance. There are no varieties available to commercial farmers with complete resistant to late blight. Material is available with some resistance to late blight which are used by organic growers, but they too can require additional control measures to keep blight out.

There is surely enough evidence out there that Ireland would benefit from a GM-free status, for its own food supply, and for the export market. This trial could reduce our foreign status significantly, when many countries on the European

Mainland are reducing, and even banning, GM crops. We will lose our foothold, and our exports, at a very critical time in our economic history.

Ireland is not GM free and the proposed work will not be the first use of GM in the country. GM sugar beet was grown in field experiments some 13 years ago and we import almost 1 million tonnes of GM animal feed every year to support our food export industry. The proposed environmental study will therefore not compromise our export market.

The proposed study is at odds with Ireland's green image and is at odds with initiatives by other agencies such as Bord Bia

It would be irresponsible of Teagasc to contemplate such a scenario as the organisation's role is to underpin the Irish agri-food industry and no other agency has done more to achieve this. Each year Teagasc invests millions in agri-environmental research projects, which support the development of environmentally conscious farming methods and minimise the impact of farming on our water and soils. The proposed study is about quantifying the impact of a blight resistant potato on levels of soil biodiversity. By acting in this manner Teagasc is addressing the GM question in a responsible and contained manner that will not impact on existing crop systems and will not compromise Ireland's world leading food export market.

Heritage seeds are important for genetic diversity. Creating clones of crops reduces this genetic diversity, and therefore evolution of the crop to cope with Irish conditions will not happen.

Genetic diversity is important as a source of useful genes in breeding programmes, but all varieties of potato are clonal, as they are multiplied from tubers rather than sexual reproduction, the variety we are proposing to test is no different to this. However this can be seen as a benefit because, as it is clonal, its potential to spread outside the confines of the managed environment of a field is restricted. Useful genes from heritage varieties (or wild relatives) can be used to produce new improved varieties of potatoes either through conventional breeding or more rapidly by developing cisgenic lines.

What scientific background do the scientists carrying out this trial hold? Have they worked with other agri-tech industries, and will one of the main industries be given the contract if the field trial 'succeeds'?

The scientists involved in this study are qualified crop scientists with no affiliation to any industry. Since the GM research programme was started at Oak Park in 2002, Teagasc have not received, nor sought, any funding from either side in relation to the GM debate. The variety being tested is not from a biotech company but from publically funded research in Europe. There will be no 'contract' at the end of the study. The objective of this work is to quantify the environmental impact of a blight resistant potato compared to a conventional potato system and make that information publicly available so as to address the current knowledge deficit that exists for Irish-specific crops.

In the USA, organic standards have been weakened due to the contamination by GM pollen (which now allow up to 2% GM in their crops). Although I understand this will not happen with GM potatoes under this trial, if they do get to the market, these potatoes will go to seed, and they will contaminate heritage varieties, so our organic standards will be compromised.

There is no commercial interest in this project and Teagasc is not in the business of developing GM crops for commercialisation. In regards to the coexistence of GM and non-GM potato systems, we have researched this with the goal of designing crop strategies to preserve the genetic integrity of non-GM potato crops. Coexistence is possible for potato due to the biology of the crop but there must be adequate regulatory measures put in place by the Irish competent authorities to ensure that it is maintained. As outlined above potato varieties are preserved through the clonal propagation of tubers, as soon as a potato variety sets true seed the resulting plants are no longer the variety you started with, whether they cross with a GM or another conventional variety. The use of GM varieties would not therefore alter the risk of loosing heritage varieties compared to what we have lived with since potatoes varieties were first bred by man.

What are the details of the genetic constructs used to generate the GM potato?

This information has been included in the Teagasc submission to the EPA and is available at www.epa.ie.

Why is Teagasc spending taxpayer's money on this research?

This project is funded through the European Framework 7 programme and the Irish study is part of a larger EU project. Entitled 'AMIGA' (Assessing and Monitoring the Impacts of Genetically modified plants on Agro-ecosystems), the project has 22 partners from Research Centres, Universities, State Agencies and SMEs across 15 EU countries. The main objectives of AMIGA are to:

- Provide baseline data on biodiversity in agro-eco-systems in the EU,
- Identify suitable bio-indicators that permit a better integration of GM field experimentation across specific agricultural ecosystems in the EU,
- Deliver an improvement of knowledge on potential long-term impacts of specific GM crops,

It is important to note that the alternative to public-funded research is to wait for privately funded programmes to deliver the research assessments. While that work may be scientifically sound, it cannot claim to be impartial and as such would not contribute constructively to the public's desire for unbiased information on this matter.

Notes