GM Team
Department for Environment, Food and Rural Affairs
Area 1C, Nobel House
17 Smith Square
London, SW1P 3JR
Submitted by email to gm-regulation@defra.gsi.gov.uk

14 December 2016

Dear Madam/Sir

Re: Application from Rothamsted Research to release a genetically modified organism, reference 16/R8/02 as published at https://www.gov.uk/government/publications/genetically-modified-organisms-rothamsted-research-16r0802

We are writing on behalf of GM Freeze, the Soil Association, Garden Organic, the Organic Growers Alliance, WWOOF UK, Biodynamic Association, Shepton Farm, Whole Organic Plus, SE Essex Organic Gardeners, The Kindling Trust, Unicorn Grocery, the Real Bread Campaign, Loopy Food, Greenaissance, the Kitchen, Friends of the Earth (England, Wales and Northern Ireland), Friends of the Earth Cymru, West Dorset Friends of the Earth, Cardiff Friends of the Earth, Sevenoaks Friends of the Earth, South Gloucestershire Friends of the Earth, Action Against Allergy, War on Want, Gaia Foundation, Find Your Feet, Mums Say No to GMOs, GM Free Dorset, Beyond GM, GM Watch, Gene Watch UK and EcoNexus to request that the above application to release genetically modified (GM) wheat is refused.

GM Freeze is the umbrella campaign for a moratorium on GM in food and farming in the UK.

The Soil Association is the UK's leading membership charity campaigning for healthy, humane and sustainable food, farming and land use. **Garden Organic** (formerly known as the Henry Doubleday Research Association) is the UK's leading organic growing charity with over 20,000 members throughout the UK and abroad. **The Organic Growers Alliance** supports and represents growers involved in commercial organic horticulture. **WWOOF UK** (World Wide Opportunities on Organic Farms) is a membership charity which connects people wanting to learn about ecological growing and low impact lifestyles with sites across the country living ethically and needing practical help on the land. **Biodynamic Association** is a UK charity that promotes this uniquely holistic approach to organic agriculture, gardening, food and health. **Shepton Farm** in Somerset grows grass/clover, arable crops and apples. **Whole Organic Plus** advises on organic production, food quality and health. **SE Essex Organic Gardeners** promotes the principles of organic gardening. **The Kindling Trust** is working towards a just and ecologically sustainable society.

Unicorn Grocery in Manchester has pioneered a cooperative approach to sustainable urban food supply**.** **The Real Bread Campaign**, part of the food and farming charity Sustain, finds and shares ways to make bread better for us, better for our communities and better for the planet. **Loopy Food** is the Directory of Food with values: local, organic, open-pollinated, yummy! **Greenaissance** promotes the Green Renaissance. **The Kitchen** is a co-operative café using simple, fresh ingredients to create tasty, affordable and nutritious food.

Friends of the Earth (England, Wales and Northern Ireland) and **Friends of the Earth Cymru** exist to create a just world where people and nature thrive. **West Dorset Friends of the Earth, Cardiff Friends of the Earth, Sevenoaks Friends of the Earth** and **South Gloucestershire Friends of the Earth** work to deliver these aims at a local level.

Action Against Allergy provides information and support to those made chronically ill through different forms of allergy and those who care for them. **War on Want** fights against the root causes of poverty and human rights violation, as part of the worldwide movement for global justice. The **Gaia Foundation** works with local and indigenous communities, civil society groups and social movements to restore a respectful relationship with the earth. **Find Your Feet** helps families build a future free from poverty.

Mums Say No to GMOs is a coalition of mothers and their families using consumer pressure to stop GM crops being grown and sold in the UK. **GM Free Dorset** is a grass roots campaign supported by individuals, groups, local businesses and charities that exist to promote rural sustainability. **Beyond GM** is a UK campaigning group raising the level of public understanding and engagement with issues around GMOs. **GM Watch** is a news and information service that aims to keep the public up to date on issues around GM crops and foods and associated pesticides. **GeneWatch UK** monitors developments in genetic technologies from a public interest, human rights, environmental protection and animal welfare perspective. **EcoNexus** analyses developments in science and technology and their impacts on environment and society.

We do not believe that this trial should go ahead. The information provided by the applicant is incomplete. The inclusion of antibiotic resistance and herbicide tolerance genes mean that it is vital that the trial crop does not escape from the trial, but that is exactly what has happened on multiple occasions with GM wheat

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trials elsewhere. The claimed potential gains from this trial are achievable through other means and there is simply no market for the trial's eventual end product.

In summary, our objection covers the following points:

1. Technical concerns relating to the information provided by the applicant
   1.1. The applicant has not performed adequate molecular characterisation, having failed to analyse the location of DNA sequences.
   1.2. The GM wheat contains an antibiotic resistance marker gene.
   1.3. The GM wheat is tolerant to glufosinate-based herbicides.

2. The potential for escape and contamination
   2.1. There have been multiple escapes of GM wheat from field trials in the United States.
   2.2. The containment measures proposed by the applicant are inadequate.

3. The false premise that it is necessary to increase yield with GM crops
   3.1. A toolbox of more sophisticated, and less risky, conventional methods for breeding wheat to increase yield is already available.
   3.2. Measures to realise existing yield potential will have more impact because environmental and management practices, as well as specific location, determine the actual yields achieved.
   3.3. It is inaccurate to say that increasing yield will feed the hungry. It is known that the global supply of food is already enough to feed 10 billion people (the world's 2050 projected population peak). Instead we should be looking at distribution and waste management, not increased yields.
   3.4. Food security requires agroecological approaches focusing on diversity and resilience to environmental stress.

4. There is no market for GM wheat

1 TECHNICAL CONCERNS RELATING TO THE INFORMATION PROVIDED BY THE APPLICANT

1.1. Characterisation of the location of DNA sequences has not been performed

Section 4.1, question 14 of the application requires:

> "14. The following information on the sequences actually inserted or deleted:
> the size and structure of the insert and methods used for its characterisation, including information on any parts of the vector introduced into the genetically modified plant or any carrier or foreign DNA remaining in the genetically modified plant, the size and function of the deleted region or regions, the copy number of the insert"

The applicant states "We have not analysed the position or the structure of the insertion nor sequenced the flanking genomic DNA."

This is wholly unacceptable and clearly does not fulfil the information requirements. The genetic engineering was performed using microprojectile bombardment, which often produces fragments and rearrangements[1]. Two genetic constructs were co-bombarded (Part A, para 11), increasing the likelihood of producing fragments and rearrangements. Such fragments and rearrangements can be important in terms of evaluating potential impacts on the environment and food/feed safety as they can give rise to unexpected and unpredictable effects. For example, an unexpected alteration in plant chemistry might produce a toxic compound.

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This application for an environmental release should be rejected on the grounds of insufficient molecular characterisation alone.

1.2. The GM wheat contains an antibiotic resistance marker gene.

The GM wheat contains the nptI gene which confers resistance to the antibiotic kanamycin and related aminoglycoside antiobiotics, and the bla gene which confers resistance to the antibiotic ampicillin. Although a consideration of the risks posed by nptI is given (Part 4A), there is none given to the bla gene. Presumably, this is because it is not expected that bla forms a part of inserted genetic cassette. However, given the lack of molecular characterisation, the risks associated with its presence in the GM wheat should be evaluated.

The applicant admits (Part 4A) that "it cannot be completely discounted that some bacteria may successfully take up the nptI gene." However, they do not consider the findings by Chinese researchers that synthetic antibiotic-resistance genes were found in microorganisms in Chinese rivers, apparently from plasmids in lab-waste[2]. The applicant states (Para 35b) that "*the remaining grain obtained will be disposed of in deep landfill using an approved contractor. All straw will be chopped and left on site."* This is unacceptable as the genetic material, including the antibiotic marker resistance gene(s) will still come into contact with biota, on the surface of the soil and also at depth within the soil.

Although the nptI gene will be in the plant DNA, rather than a plasmid, the Chinese study shows that antibiotic resistance marker genes can persist in environments, even when no selection pressure is applied, and can be taken up into organisms. Therefore, decomposition into the soil cannot be assumed, also taking into account the persistence rate of DNA in soil.

Kanamycin is on the United Nations World Health Organisation (WHO)'s list of essential medicines for priority diseases[3]. The use of any antibiotic marker gene in GM plants, even if solely for field trial purposes is irresponsible given the amount of concern regarding antibiotic resistance globally (eg WHO's World Antibiotic Awareness Week).

1.3. The GM wheat is tolerant to glufosinate-based herbicides

The GM wheat in the proposed field trial is tolerant to glufosinate-based herbicides, for example glufosinate ammonium. This tolerance arises from the presence of the *bar* gene from the pAHC20UbiBar plasmid. Although glufosinate is not intended to be used in the proposed field trial, the presence of this trait poses risks.

In 2013, GM Freeze[4] noted, in its objection to the application for a variation to the GM wheat trial 11/R8/01 that, in addition to increasing the survivability of GM wheat in environments where glufosinate herbicides are the only ones used, *"in the future the presence of the glufosinate ammonium tolerance gene could be used as an agronomic trait in a commercial variety to make it attractive to farmers wishing to control weeds in cereal crops. The results of the UK's Farm Scale Evaluations clearly showed that GM herbicide tolerant Spring and Winter oilseed rape with tolerance to glufosinate ammonium had a significant impact on the flowering plant species in arable fields compared to the current herbicide regime used on conventional crops. This would also have a significant impact on numbers of arable weeds and insects, which form a vital food resource for farmland wildlife and would harm many species. Furthermore, the development of a dependence on glufosinate ammonium for weed control in cereals could lead to the development of resistance in major arable weeds leading to an escalation in herbicide usage and costs, as has happened in Roundup Ready crops in the US and South America."*

The applicant notes the presence of wild relatives of wheat (paras 28 and 35), in particular two species in the genus *Elytrigia – Elytrigia repens* (common couch) and *Elymus caninus* (bearded couch). The applicant states that "*E. repens will be controlled along with other weeds in and around the trial site using standard farm practices*", although it is not clear what these "standard farm practices" are, nor how effective they may be.

GMFreeze[5] has noted previously that common couch "*is already an extremely troublesome weed in cereal and other arable crops, as well as in many other crops and gardens, so the application should be refused to remove the chance of outcrossing occurring. A chance crossing between the GM wheat and a couch plant would result in glufosinate ammonium resistance developing in couch as a consequence of the presence of the marker gene.*" And that "*Before the UK trials of GM oilseed rape began it was stated that cross-pollination between the crop and the common arable weed charlock (Sinapsis arvensis) was impossible under field conditions. Yet during the Farm Scale Evaluations from 2000-2003 such a cross did occur. This demonstrated that rare events do occur under natural conditions. The creation of a population of glufosinate ammonium resistant couch could cause serious agronomic problems for farmers in the long term and lead to an increased use of herbicides to control it.*"

As in 2013, the presence of the glufosinate tolerance marker gene creates unnecessary risk, and the application should be rejected because of it.

2. THE POTENTIAL FOR ESCAPE AND CONTAMINATION

2.1. Multiple escapes of GM wheat from field trials in the United States (US)

No GM wheat is approved for commercial cultivation anywhere in the world. Although GM Roundup Ready wheat was developed by Monsanto in the late 1990, the programme was discontinued in 2004 because of opposition from wheat farmers[6,7]. However, there have been field trials, notably in the US.

In the US, GM wheat has been discovered growing outside field trials on 3 separate occasions. Glyphosate tolerant (Roundup Ready) wheat containing the genetic insert used in MON71800 was discovered in Oregon in 2013[8]. Another type of Roundup Ready wheat, also containing the MON71800 insert but genetically distinct, was found in Montana in 2014[9]. Yet another type of glyphosate tolerant wheat, MON71700, was discovered in Washington State in July 2016[10]. These discoveries prompted halts to purchasing of US wheat in some countries[11], leading to marketing concerns for farmers and traders. Investigations by APHIS (United States Department of Agriculture – Animal and Plant Health Inspection Service)[12, 13] failed to find the route of contamination in these cases but have led to an overhaul of the US regulations for field trials of wheat[14].

The first discovery, in Oregon, occurred by chance when a farmer noticed that volunteer (ie not deliberately planted by a farmer, but growing) wheat plants in his fields did not die when sprayed with glyphosate[15]. This volunteer wheat was a hybrid that included "genetic material from other types and varieties of wheat, along with a GM glyphosate-resistant wheat trait developed by Monsanto that confers resistance to Roundup herbicide"[16]. The volunteer wheat was a winter wheat variety, whilst the field trials in Oregon had been a spring wheat variety[17]. Thus, the GM trait appears to have been transferred to a different wheat variety, presumably via outcrossing.

An investigation by USDA (United States Department of Agriculture) and APHIS into the Oregon case involved 291 interviews with wheat growers, grain elevator operators, crop consultants and wheat researchers. It produced a 12,000 page report but failed to find the route of the contamination: "*After* *exhausting all leads, APHIS was unable to determine exactly how the GM wheat came to grow in the farmer's field*"[18]. Field trials of Roundup Ready wheat took place between 1998 and 2005[19] and Monsanto closed its GM Roundup Ready wheat development program in 2004[20]. This means that the rogue GM wheat was only discovered between eight and 15 years after the GM Roundup Ready wheat field trial it presumably escaped from.

The Montana discovery, in 2014, was at an agricultural research centre where researchers grew GM wheat as part of field trials between 2000 and 2003[21]. This means that the wild growing wheat was discovered over 10 years after the end of field trials for GM Roundup Ready wheat at that site. However, it's not yet known whether the type of GM Roundup Ready wheat found in Montana is the same as (or different from) the types of GM Roundup Ready wheat that were the subject of field trials at the research centre because USDA-APHIS has not yet concluded its investigation[22].

In response to these two incidents USDA-APHIS replaced the simple notification-based system with permit-based regulations, specifically for GM wheat trials[23]. Despite this, a third discovery of GM wheat escaping from a field trial occurred in 2016[24]. This GM Roundup Ready wheat, discovered growing wild on a farm, was of a third type, not traceable to either of the two earlier incidents.

Altogether, these incidents present a worrying picture of how easy it is for GM wheat to escape from field trials and remain a GM contamination threat for many years. In particular, they show:

- Escapes of GM wheat appear to have occurred from 3 separate field trials, relating to 3 separate GM wheat events.
- In the Oregon case, the GM wheat plants were found at a site where GM wheat field trials had not taken place, nor was the GM contamination able to be traced to a particular field trial, implying that GM wheat contamination can occur at locations outside of the GM field trial area, and in unexpected places.
- Transfer of the GM trait to different wheat varieties appears to have occurred – possibly via outcrossing.
- Routes of contamination are not apparent – it is not possible to develop mitigation measures against unknown routes of contamination.
- The rogue GM wheat discoveries were made by chance, in two cases by farmers. They were discovered because the GM wheat was tolerant to a commonly used herbicide - glyphosate. If the trait had been for increased yield or to a less commonly used herbicide, eg glufosinate in the EU, these escapees might have remained undetected for longer.
- GM wheat escapees can remain either undetected or dormant for over 10 years.
- Escapes from GM wheat field trials pose a considerable threat to the wheat trade and, in particular, wheat exports.

As UDSA-APHIS[25] summarise:
"During 2013 and 2014, USDA investigated two separate incidents involving regulated GE wheat in Oregon and Montana. Although the regulated wheat at both locations contained a glyphosate resistant trait known as MON71800 developed by Monsanto, the wheat at the two locations was genetically distinct. Field trials of GE wheat were never authorized at the site in Oregon, and the last authorization for a field trial of MON71800 at the Montana site expired over 10 years ago. All field trials of GE wheat involving MON71800 were conducted under notification. The last field trial of MON71800 in the United States was authorized in 2005, with most field trials completed by 2004.

It became clear to us following the GE wheat incident in Oregon that the detection of regulated GE wheat where it was not authorized, had great potential to disrupt wheat markets globally. And in fact, some US trading partners continue to apply additional risk mitigation measures to imports of US wheat in response to that 2013 incident. Using permits for field trials of GE wheat provides an additional level of safeguarding based on, and consistent with the biology of wheat."

In an effort to prevent further escapes from GM wheat field trials, USDA -APHIS[26] reviewed the seed dormancy of wheat:

"*Wheat is capable of extended dormancy and reported survival times vary widely depending on environmental conditions. In dry regions, wheat seed can survive in the soil beyond two years (Anderson and Soper, 2003; Beckie et al, 2001; De Corby et al, 2007; Harker et al, 2005; Leeson et al, 2005; Nielson et al, 2009; Pickett, 1989; Pickett, 1993; Seerey et al, 2011; Willenborg and Van Acker, 2008). There was even a report of seed survival of up to five years in certain situations (Beckie et al, 2001). Therefore, a two year monitoring period may be insufficient where rainfall is limited and irrigation is not employed."*

The implications of the escape of US GM wheat from field trials to the proposed UK GM wheat field trial are described below. In particular, the proposed monitoring period of only one year post field trial contrasts greatly with the decade-long time scale between cessation of GM wheat field trials in the US and the discovery of the rogue GM wheat.

2.2. The containment measures proposed by the applicant are inadequate

It is clear from the incidents described above that GM wheat cannot be controlled, even in a field trial situation. The fact that it has not been possible to determine the route(s) of GM contamination in the US means that it isn't possible to guarantee that containment measures will be effective. It seems that, in certain circumstances, wheat seeds can remain dormant for several years, and the evidence also suggests a possibility of outcrossing (eg the transfer of genes from spring to winter wheat).

Given the US experience, the containment measures proposed by the applicant are inadequate. Wild GM wheat has appeared well outside authorized field trial sites so the exclusion of wheat plants from a 20 m area around the site cannot be assumed to be effective. The applicant acknowledges that dispersal of seed by wildlife is possible (para 6) but proposes a chain-link fence designed to only "*prevent the entry of rabbits and other large mammals including unauthorised humans*" (para 18). Small mammals, such as mice, and possibly other small animals, may also be important in seed dispersal and could pass through this chain-link fence.

The applicant's proposal to monitor the site for only one year beyond the duration of the proposed trial is wholly inadequate, as the US GM contamination cases arose between eight and 15 years after field trials were conducted. Higher UK rainfall may reduce seed dormancy in comparison with sites of contamination in the US (where a 2 year monitoring period is now considered inadequate), but seed could be transported, eg by small mammals, to dry sites where it could remain dormant for several years.

The GM wheat in this proposed trial could have enhanced fitness and survivability. The applicant notes (para 16) that "*the survivability of these plants in unmanaged systems may be affected by their enhanced photosynthesis. In addition, these plants possess the ability to tolerate glufosinate-based herbicides which would increase their survivability in environments where these herbicides were the only ones used.*" Any enhanced ability to grow or reach maturity would increase the risk of GM contamination of UK wheat in the event of the escape of GM wheat seeds or pollen from the field trial site.

The potential impact of escape of either GM seeds or GM pollen from this proposed GM wheat field trial is severe. Wheat is vital to UK food security and to our rural economy. Exports would be severely affected by any GM contamination and typically, 15-20 % of the UK wheat harvest is exported[27]. The proposed GM field trial should be rejected on the grounds that it could lead to highly disruptive GM contamination of UK wheat.

3. THE FALSE PREMISE THAT IT IS NECESSARY TO INCREASE YIELD WITH GM CROPS

3.1. Wheat yield potential can be improved by more sophisticated and less risky conventional breeding methods

The technology used to create this GM wheat is crude and old fashioned. It relies on projectile bombardment, where the genetic constructs are integrated randomly at unknown and unspecified locations within the genome. The genetic modification strategy to increase yield relies on the over-expression of a single gene (under a constitutive promoter, ie that is on in every cell, all the time) giving rise to higher concentrations of an enzyme, SBPase, involved in photosynthesis. However, wheat yield relies not only on photosynthesis, but also on export and storage of photosynthesis products[28]. Wheat yield is a complex trait controlled by multiple genes. It is unlikely that the overexpression of a single gene will provide universal increases in wheat yields.

As the developers of the GM wheat acknowledge in a recent publication[29], "*Importantly, there is no single solution for optimizing CO_2 assimilation in crops and useful solutions will need to be tailored to the intended growth environment. The delicate balance between RuBP consumption (Rubisco activity) and regeneration (Calvin cycle) needs to be considered in attempts to optimize Rubisco function and regulation to enable greater photosynthetic resource use efficiency in current and projected climates.*" Indeed, genetic engineering that attempts to alter plant metabolic pathways is likely to result in unexpected effects: "*[Plant metabolic] pathways pull components from various genetic tool kits; some of those components evolve independently and others do not. A push in one place can produce unexpected responses in other pathways. And metabolic pathways multiply with modifications, tweaks, and twinges every step of the way.*"[30]

Strategies to breed crops with increased yield do not require genetic engineering. Indeed, it is questionable whether the genetic engineering approach taken by the applicants, or other researchers[31], is a suitable method at all. Modern conventional breeding techniques offer significant advantages over genetic engineering when seeking to manipulate complex traits such as yield. With marker assisted selection (MAS), the ability to combine knowledge of genomics with conventional breeding allows many desired genes to be incorporated at once into a single variety. Indeed, progress has been made with MAS approaches to wheat breeding now that the draft sequence of the wheat genome is available[32], allowing the development of molecular markers[33,34].

Other forms of "physiological breeding" are also being utilised[35], including wide crosses and phenotypic selection. Such approaches have already been successful in increasing the yield potential of wheat[36].

Wheat yield is an area of active non-GM research and development. A toolbox is already available for the conventional breeding of wheat to increase yield in more sophisticated, and less risky, ways than the genetic engineering approach in this proposed trial. Genetic engineering is not needed to increase wheat yield.

3.2 Measures to realise existing yield potential will have more impact

While all wheat varieties have a theoretical "genetic potential" for yield, the huge variety in performance from farm to farm and year to year indicate that environmental and management practices, as well as specific location, determine the actual yield realised[37].

GM Freeze has already outlined measures that could significantly increase yield[38], such as prioritising the control of black grass (*Alopecurus myosuroides*) in the UK. GM Freeze also reported from a review by HGCA (Home Grown Cereals Authority)[39] which identified the following as significant factors in lowering yields:

- Deep soil compaction due to heavy machinery causes poor drainage and can reduce cereal yield by 16% on average. HGCA says 15% of wheat fields are not regularly mole drained to alleviate deep soil compaction.
- Short rotations – growing wheat in successive years (second wheat) has a yield penalty of 10%, increasing to 14% in subsequent wheat crops.
- Lack of sunshine at critical periods of crop development (eg when grains are filling).
- Heat stress caused by very high temperatures.
- Late sowing.
- Sub-optimal planting density.
- Soil pH outside the optimum range for wheat (ie, more acidic soil such as sand).
- Sub-optimal availability of nitrogen (application rates being strongly influenced by fertilizer prices and gross margins).
- Deficient soil availability of phosphorus and potassium can reduce yields by up to 0.006tonnes/hectare/year.
- Soil availability of sulphur can reduce yields by up to 0.4 tonnes/hectare.
- Failure to adequately control or prevent fungal pathogens (eg take-all and septoria).
- Minimal tillage reduces yield immediately, and a decline of 0.004 kilogrammes/hectare/year is indicated.

3.3 Increasing yield will not feed the hungry

The applicant chose to promote this trial in the press before it had been granted consent, with headlines praising "GM wonder wheat made with gold dust to feed the world's poor"[40]. Their own website uses less melodramatic phrasing but nevertheless presents the motivation for this trial as "[e]nsuring food security", in light of "the projected need to increase world food production by 40% in the next 20 years and 70% by 2050"[41].

We are concerned by the casual assumption that increasing yields will bring positive gains for society at large. Dr. Hans Herren of the Millennium Institute, Washington and co-chair of the IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development) states that "the world produces… enough to feed 10 billion people, the world's 2050 projected population peak"[42]. Meanwhile, the Food and Agriculture Organisation of the United Nations estimates that "about 793 million people are undernourished"[43].

World food production already far exceeds the needs of generations to come but people still go hungry. Even if this project successfully increases wheat yields, the work that Rothamsted Research is doing cannot begin to address the real causes of malnutrition. To suggest as much, as the applicant has done in the promotion of this trial, is exactly the kind of "crisis narrative" that NGO representatives highlighted as a matter of concern in a research workshop in June 2016[44].

We hear a great deal about the need to consider the potential benefits of GM when assessing the risks associated with its use. We urge the Minister to also consider the potential benefits of focusing on waste reduction, poverty eradication and the promotion of food sovereignty in deciding how to spend public money and which risks are worth taking.

3.4 Food security requires agroecological approaches focusing on diversity and resilience to environmental stress

Although some climate change models predict an increase in wheat yields for the UK, others view the response of wheat to climatic changes as more complex with heat stress causing substantial reductions in yield, even in the UK[45]. Therefore, research developing traits that can help tolerate stress induced by heat or drought in wheat are more desirable than those that increase the genetic potential for yield.

Resilience relies on diversity and researchers consider that widening the gene pool of wheat (eg by crossing with wild relatives) is an essential part of breeding new varieties for adaption to climate change[46]. By contrast, genetic engineering approaches narrow the genetic pool by focusing on existing varieties[47].

Whilst plant breeding can provide drought or heat tolerant varieties, it is not possible to know what to plant in any given year, due to the unpredictability of the weather. Diversity (genetic, crop and landscape) can help by providing an "insurance policy" as some varieties/crops will do better than others in any given season. It can also help with disease and pest suppression and increase production[48].

Agroecological approaches, such as organic farming, place an emphasis on diversity. They encourage healthy soils, which not only enhance soil fertility but have good water holding characteristics, increasing resilience to drought. Agroecological approaches also provide benefits for biodiversity, which GM crops do not. Such approaches are urgently needed, given the current poor state of wildlife in agricultural systems[49].

Furthermore, agricultural practices like intercropping can increase yield. Research in Ethiopia could for example show that intercropping of wheat and faba beans increased yield by 20% in that system[50]. The authors state: "*In conclusion, intercropping of wheat with faba bean may increase total yield and revenue, reduce weed and disease pressure, increase land-use efficiency, and thereby enhance sustainability of crop production in Ethiopian highlands*."

4. THERE IS NO MARKET FOR GM WHEAT

Public opinion in the UK is "decisively negative" towards GM foods, with four out of ten adults holding negative views, according to a 2013 poll[51]. All major UK supermarkets have a policy of not stocking GM produce for human consumption. This has been the case for nearly two decades, and there are no indications from the major retailers (based on our regular interactions with them) that they would alter their policy in the case of GM wheat.

Traders have indicated that they do not want GM wheat either. Monsanto abandoned its GM Roundup Ready wheat research programme in 2004, after consultation with wheat traders[52]. Although the research programme has recently been restarted, any GM wheat products are "at least a decade away from commercial approval"[53]. It is significant that Monsanto's current flagship wheat varieties are non-GM, having been developed for increased yield by marker assisted selection[54].

Wheat is an iconic product to Europeans, including the British. It is something that is eaten daily by many people with minimal processing, particularly in bread. This is exemplified by the Soil Association's petition to ban glyphosate highlighting the detection of glyphosate in bread[55].

This trial represents a risk to farmers, to the UK wheat industry and to the environment. It is justified by a false premise and any potential benefits can be more effectively achieved through less risky means. We request, therefore, that the Minister denies consent and prevents this open-air field trial from going ahead.

Yours faithfully

Liz O'Neill Director **GM Freeze**	Peter Melchett Policy Director **Soil Association**	Sally Beare Campaigner **Mums Say No to GMOs**	Scarlett Penn Chief Executive **WWOOF UK** (World Wide Opportunities on Organic Farms)	Jane O'Meara Spokesperson **GM Free Dorset**
Clare Oxborrow Senior Campaigner **Friends of the Earth (England, Wales and Northern Ireland)**	Dr Helen Wallace Director **GeneWatch UK**	Dr Dan Taylor Director **Find Your Feet**	Dr Ricarda Steinbrecher Co-Director **Econexus**	Pat Thomas Director **Beyond GM**
James Campbell Chief Executive **Garden Organic**	Haf Elgar Campaigne **Friends of the Earth Cymru**	Helen Woodcock Director **The Kindling Trust**	Pat Schooling Executive Director **Action Against Allergy**	
Liz Hosken Director, **The Gaia Foundation**	Peter Brown Director, **Biodynamic Association**	Debbie Clarke Director, **Unicorn Grocery Ltd**	Carole Shorney Secretary, **South East Essex Organic Gardeners**	
Claire Robinson Editor **GM Watch**	Adina Claire Interim Executive Director **War on Want**	Chris Young Coordinator **The Real Bread Campaign**	Alan Schofield Chairman **Organic Growers Alliance**	
Chris Brown Coordinator **Cardiff Friends of the Earth**	Alan Pinder Coordinator **South Gloucester Friends of the Earth**	Kath Baron Secretary **The Kitchen**	Oliver Dowding Farmer **Shepton Farms Limited**	
Mike Fowler Coordinator **West Dorset Friends of the Earth**	Lawrence Woodward Director **Whole Organic Plus**	Adrian Patch Director **Loopy Food** and ***Greenaissance***	Caroline Copleston Treasurer **Sevenoaks Friends of the Earth**	

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