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Stakeholder questionnaire on new genomic techniques to contribute to a Commission study requested by the Council

Fields marked with * are mandatory.

Questionnaire on new genomic techniques to contribute to the study requested by the Council

Discussed and finalised in the Ad-hoc Stakeholder meeting on 10 February 2020

Background

The Council has requested [1] the Commission to submit, by 30 April 2021, "a study in light of the Court of Justice's judgment in Case C-528/16 regarding the status of novel genomic techniques under Union law" (*i.e.* Directive 2001/18/EC, Regulation (EC) 1829/2003, Regulation (EC) 1830/2003 and Directive 2009/41/EC).

To respond to this Council's request, the Commission is collecting contributions from the stakeholders through the questionnaire below. The study covers all new genomic techniques that have been developed after 2001.

Instructions

For the purpose of the study, the following definition for new genomic techniques (NGTs) is used: techniques that are capable of altering the genetic material of an organism and which have emerged or have been developed since 2001 [2].

Unless specified otherwise, the term "NGT-products" used in the questionnaire covers plants, animals, micro-organisms and derived food and feed products obtained by NGTs for agri-food, medicinal and industrial applications and for research.

Please substantiate your replies with explanations, data and source of information as well as with practical examples, whenever possible. If a reply to a specific question only applies to specific NGTs/organisms, please indicate this in the reply.

Please indicate which information should be treated as confidential in order to protect the commercial

interests of a natural or legal person. Personal data, if any, will be protected pursuant to Regulation (EU) 2018/1725 [3].

[1] Council Decision (EU) 2019/1904, OJ L 293 14.11.2019, p. 103-104, https://eur-lex.europa.eu/eli/dec/2019/1904/oj
[2] Examples of techniques include: 1) Genome editing techniques such as CRISPR, TALEN, Zinc-finger nucleases, mega nucleases techniques, prime editing etc. These techniques can lead to mutagenesis and some of them also to cisgenesis, intragenesis or transgenesis. 2) Mutagenesis techniques such as oligonucleotide directed mutagenesis (ODM). 3) Epigenetic techniques such RdDM. Conversely, techniques already in use prior to 2001, such as Agrobacterium mediated techniques or gene gun, are not considered NGTs.
[3] Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC, OJ L 295, 21.11.2018, p. 39–98

Guidelines

Please note that the survey accepts a maximum of 5000 characters (with spaces) per reply field. You might be able to type more than 5000 characters, but then the text will not be accepted when you submit the questionnaire. You will also receive a warning message in red colour below the affected field.

You have the option to upload supporting documentation in the end of each section. You can upload multiple files, up to the size of 1 MB. However, note that any uploaded document cannot substitute your replies, which must still be given in a complete manner within the reply fields allocated for each question.

You can share the link from the invitation email with another colleague if you want to split the filling-out process or contribute from different locations; however, remember that all contributions feed into the same single questionnaire.

You can save the draft questionnaire and edit it before the final submission.

You can find additional information and help here: https://ec.europa.eu/eusurvey/home/helpparticipants

Participants have until 15 May 2020 (close of business) to submit the questionnaire via EUsurvey.

QUESTIONNAIRE

Please provide the full name and acronym of the EU-level association that you are representing, as well as your Transparency Registry number (if you are registered)

If the name of the association is not in English, please provide an English translation in a parenthesis

IFOAM EU Group 67128251296-84

Please mention the sectors of activity/fields of interest of your association

Organic agriculture and food production

If applicable, please indicate which member associations (national or EU-level), or individual companies /other entities have contributed to this questionnaire

If applicable, indicate if all the replies refer to a specific technique or a specific organism

A - Implementation and enforcement of the GMO legislation with regard to new genomic techniques (NGTs)

* **1. Are your members developing, using, or planning to use NGTs/NGT-products?**

- ○ Yes
- ◉ No
- ○ Not applicable

* Please explain why not

(1) Our members are not using or planning to use NGT-products since the use of GMOs is prohibited in the organic value chain. This is specified in the current Organic Regulation 834/2007 Art. 4 and the New Organic Regulation 848/2018, Art. 5.
(2) NGTs are not in line with the IFOAM International position on new breeding techniques, as for the organic sector not only the product but also the process is important.

* **2. Have your members taken or planned to take measures to protect themselves from unintentional use of NGT-products?**

- ◉ Yes
- ○ No
- ○ Not applicable

* Please provide details

Our members are making use of the information that is provided via the traceability system that is affixed in Regulation 1830/2003 to ensure that the (intermediate) products do not contain GMOs. 'GMO' in this context means a genetically modified organisms as defined in point (2) of Article 2 of Directive 2001/18/EC (and not obtained through the techniques listed in Annex I.B of that Directive), which by clarification of the European Court of Justice (C-528/16), includes products form new mutagenesis techniques. Our members keep a close watch (on the basis of information publicly available) on which products from NGTs are marketed, for which crops and which geographical areas. The current organic regulation (EC) 834/2007 specifies the prohibition on the use of GMOs in Article 9. As soon as (EU) 2018/848 comes into effect, our members will be implementing the requirements laid down in Article 11 which specifies the prohibition of the use of GMOs in organic products. Regulation (EU) 2018/848, Art. 11 (4) specifies that operators using non-organic products purchased from third parties shall require the vendor to confirm that products are not produced from GMOs or produced by GMOs if those products are not covered by the traceability system that is specified in Directive 2001/18/EC, Regulation (EC) No 1829/2003 or Regulation (EC) No 1830/2003. Like for GMOs currently on the market, organic operators will have to take extra measures to avoid the unintended presence of products from new GE techniques in their products. For example, in order to keep their breeding program free from products of NGTs, organic breeders do not use propagating material from countries (for instance the USA) where NGTs may be used without labelling.

* 2 bis. Have you encountered any challenges?

- (•) Yes
- ( ) No

* Please provide details

Our members of the organic movement are depending on the proper functioning of the traceability system and the legal security that it provides to all the actors throughout the chain of production. To live up to the legal requirements, our members effectively rely on the documentation accompanying a product that have been affixed or provided pursuant to Directive 2001/18/EC, Regulation (EC) No 1829/2003 of the European Parliament and of the Council or Regulation (EC) No 1830/2003 of the European Parliament and of the Council (in particular Article 4). However, our members are concerned with the fact that protocols for the detection of NGT-products are not established yet as part of the routine of inspections and controls that take place at the member-state level (specified in 1830/2003, Article 9). Consequently, control measures cannot guarantee the proper declaration of imports of non-organic inputs from non-EU countries and might result in fraud and the import of unauthorized GMOs into the EU market. This is especially true as NGTs in other countries are not declared as GMO and often lack mandatory declaration. For the organic sector, this is especially a concern regarding feed or non-organic inputs in breeding programs. Insufficiently transmitted information from operators could lead to unintentional presence of (unauthorized) NGT-products in organic products. This, in turn, would result in an economic loss for the organic operator and a severe loss in consumer trust into the integrity organic products (for example, 81% of German consumers indicate that the absence of GMOs is one of the reasons to consume organic (BMEL, 2019, Oekobarometer).

*** 3. Are you aware of initiatives in your sector to develop, use, or of plans to use NGTs/NGT-products?**

- ( ) Yes
- ( ) No
- (•) Not applicable

*** 4. Do you know of any initiatives in your sector to guard against unintentional use of NGT-products?**

- (•) Yes

- ○ No
- ○ Not applicable

* Please provide details

In cooperation with the Organic Research Centre, BOELW and FNAB, IFOAM EU has released practical guidelines on how to avoid GMO contamination (IFOAM EU, 2017, Practical guidelines: How to avoid GMOs contamination). These guidelines are applicable for the whole food chain, including farmers and processors of food and feed. IFOAM EU also issued an overview over specific national coexistence rules as well as recommendations for authorities at the EU, National and Regional levels.
Supply chains dedicated to organic or non-GM markets take considerable efforts in avoiding contamination at seed level. This is done by applying highly integrated approaches that require considerable sourcing and quality management costs. Strategies of value chain actors to ensure GMO-free production and processing include: (1) using breeding material that stems from regions without risk of contamination, (2) certificates, contracts, taking and keeping reserve (retention) samples, quick tests, (3) Machinery, storage, transport and distribution under own control and in closed bags, (4) Reduced exchange with companies that use GMOs, own conservation and multiplication, (5) Awareness of what neighbours do: “In one case we had to destroy a complete production on the field because of GMO-maize production in the neighbourhood” (IFOAM EU, 2017, Practical guidelines: How to avoid GMOs contamination).
Particular precaution-measures in processing entail the (1) spatial or temporal segregation of processing, (2) training of staff, (3) monitoring of suppliers, (4) product testing and cleaning, requesting cleaning certificates from transport companies (5) IP certifications (IFOAM EU, 2017, Practical guidelines: How to avoid GMOs contamination).

Coexistence measures are the competence of the member states and their scope is defined by the definition of a GMO in Directive 2001/18/EC. In line with the clarification that was provided by the ECJ ruling, NGT-products in agriculture fall under the scope of the Directive and therefore national coexistence measures.

While those measures are also applicable for NGTs, in principle, these initiatives also depend on a proper functioning of the traceability system along the whole production chain.

* 4 bis. Are you aware of any challenges encountered?

- ◉ Yes
- ○ No

* Please provide details

One challenge that the organic sector encounters is that not all farmers and processors are protected by coexistence measures. By 2014 [newer numbers?], 13 countries had no specific coexistence legislation. At least some of them, like France, have general rules on GMOs that can be related to coexistence (IFOAM EU, 2017, Practical guidelines: How to avoid GMOs contamination). Others, like the Netherlands, have developed coexistence measures for certain crops.

In practice, however, coexistence is associated with high costs for organic but also non-organic operators. While these costs were calculated for GMOs in general, costs for avoiding contamination with NGTs are likely to be applicable within comparable limits. A study on the socio-economic impacts of GMOs on European Agriculture, published by IFOAM EU and FiBL in 2017 concluded that testing at the farm level (directly supported by the suppliers) costs EUR 100/test and 100 working hours. Testing input products at their arrival at the plant costs EUR 1.67/t plus an additional analysis to verify potential contamination of up to EUR 100/t. Costs for cleaning include cleaning and cleaning certificates for trucks of EUR 10/t plus additional cleaning costs that entail transport, storage and processing facilities of up to EUR 100/t. On top, temporal segregation is set as EUR 10/t (IFOAM EU, 2017, Practical guidelines: How to avoid GMOs contamination).

In total, testing costs amount to around 0.4 to 0.6% of the annual turnover. For the breeders, the costs of losing breeding material and seeds through contaminations and the damage to reputation is even more severe. The breeding undertaken over many years could be lost. Not only the contaminated lot would need to be destroyed, but also the gene pools need to be checked for contaminations. The particular costs for seed testing in the context of breeding programmes amount to EUR 1000 – 2500/year, up to 40000 (mainly when new breeding material is introduced into the breeding programs) and are made up of EUR 180/seed lot; EUR 100/test; EUR 100/taking sample (IFOAM EU & FiBL, 2017, Socio-economic impacts of GMOs on European Agriculture, p.16).

According to maize and soy (for feed) producers in DE and FR, the potential costs in case of contamination would amount to 25000EUR for declassification of organic product, plus 15000EUR for communicating with certifier and testing of raw materials. In addition, there is the severe loss of trust with consumers which could lead to huge economic damages (IFOAM EU & FiBL, 2017, Socio-economic impacts of GMOs on European Agriculture, p.21). In countries with GM production, like Spain, the situation is different because organic farmers abandon or do not start cultivating organic maize to avoid contamination problems. This loss of potential gain (opportunity) costs was not estimated in the context of this study but poses a threat to organic producers in countries where cultivation of GMOs is taking place or might take place in the future.

* **5. Are your members taking specific measures to comply with the GMO legislation as regards organisms obtained by NGTs?**

Please also see question 8 specifically on labelling

- ○ Yes
- ◉ No
- ○ Not applicable

* Please explain why not

Our members are implementing all the required steps to comply with the GMO legislation, that includes organisms obtained by NGTs. Our members are making use of (and are dependent on) the information that is provided via the traceability system that is affixed in Directive 1830/2018 to ensure that the (intermediate) products do not contain GMOs. Also, Regulation (EU) 2018/848, Art. 11 (4) specifies that operators using non-organic products purchased from third parties shall require the vendor to confirm that those products are not produced from GMOs or produced by GMOs. To our knowledge, there are currently no specific measures are implemented with regard to organisms obtained by NGTs.

* 5 bis. What challenges have you encountered?

Detection methods/strategies have not been adapted yet to detect all products from NGTs. With adequate detection protocols not implemented by national authorities, the GMO legislation is only partially enforced as imports of unauthorized products from NGT would not be detected.

* **6. Has your organisation/your members been adequately supported by national and European authorities to conform to the legislation?**

- ○ Yes
- ◉ No
- ○ Not applicable

* What challenges have you encountered?

Insufficient implementation and enforcement of ECJ ruling by the European and member-state authorities currently leads to a situation where unauthorized NGT products could be circulating in the EU market, which is a challenge for the organic chain of production. This insufficient application is most prominently composed of the lack of lack of coordination between EU and national level to enforce the judgement and the lack of a coordinated research programme to define regulatory protocols for the traceability & detectability of NGT products.

* **7. Does your sector have experience or knowledge on traceability strategies, which could be used for tracing NGT-products?**

- ○ Yes
- ◉ No
- ○ Not applicable

* Do you have suggestions on possible traceability strategies and/or methods?

- ◉ Yes
- ○ No

* Please describe

To prevent contamination and fraud, a combination of labelling, documentation and traceability mechanisms is essential, supported by testing methods/strategies to be able to verify the presence of products of NGTs in a (possible) contamination event.
(1) NGT products already on the market: Practical problems regarding traceability could be overcome by requesting (detection) protocols from producers of the genome-edited products that are currently on the (non-EU) market, including a rapeseed (Cibus' SU Canola, produced through ODM and grown in the USA and Canada) and a soybean (Calyxt's High Oleic Soybean, produced through TALENs and grown in the USA). These products are detectable if "prior knowledge on the altered genome sequence, a validated detection method and certified reference materials are available" (ENGL, 2019, Detection of food and feed plant products obtained by new mutagenesis techniques, p. 17). To achieve this, EU-level coordination of national laboratories is crucial to design this process in an efficient manner. Currently, genome-edited organisms (authorised in EU and non-EU) are listed (without sequence information) in the EUginius database (JRC, 2019, 30th ENGL plenary meeting 1-2 October 2019, p. 7). An European Database with comparison material (referenced in Art. 9 (3) of Regulation (EC) 1830/2003) should therefore be a point of focus in order to streamline knowledge-sharing. Also, the seed authorities could play a role in the registration of information on the NGTs used in breeding programs.
(2)'Paper traceability': Even if there might not be technical tools available at the moment to detect all products from NGT, regulation can "be based on a system of sworn statements, traceability, etc", according to German government officials and DowDupont (Duensing, N. et al, 2018, Novel Features and Considerations for ERA and Regulation of Crops Produced by Genome Editing). A documentation-based approach is already successfully applied for oil products, such as oil from GM soy.
(3) Detection Methods: Precondition is full transparency and mandatory declaration of products that are derived from NGT.
(3.1) Next Generation Sequencing (NGS) based techniques: Organisms generated by genome editing require a different detection strategy than transgenic GMOs in certain cases. Fortunately, NGS-based approaches to traceability are a powerful tool for characterization of varieties based on genomic differences, of which Single Nucleotide Polymorphisms (SNPs) are the most common type of genomic variation and represent differences in a single DNA building block. In combination with the tools of bioinformatics, this technology can be used to distinguish genetically very similar varieties by making use of highly robust SNP markers (Singh R. et al, 2019, Development of model web-server for crop variety identification using throughput SNP genotyping data. Nature Scientific Reports). Those markers are then used to create a DNA-based 'signature'. According to a researcher from the ENGL network, 'deep analysis of mutations with low-error rate sequencing could provide approaches for comprehensive fingerprinting', also in the context of SDN-1 & 2 genome edited organisms (JRC, 2019, p.11). As a member of the ENGL network concluded, the technology is based on a system where somatic mutations are collected on a global scale to differentiate between a mutation introduced by 'genome editing' and a 'naturally occurring mutation'. The sequence data on somatic mutations can then be used as a molecular marker for detecting the mutation event (JRC, 2019, pp.11-12). This requires a database that is comparable to the EUginius database, along with a molecular characterisation of GM events and proposed detection methods/strategies (JRC, 2019, p. 7).
(3.2) 'Omics'-based technologies: These techniques are a useful tool to detect compositional changes that result from the application of NGTs and could be amended to be used in the EU regulatory environment. Metabolomics or 'non-targeted metabolite analysis' is an 'omics'-based downstream technique to detect compositional changes in novel foodstuffs: 'The combination of multivariate statistics and high-resolution metabolomics are likely to prove instrumental as a means for discriminating gene-edited plants from their wild-type controls as well as from spontaneous mutants or early generations of physically or chemically induced mutants' (Fraser D. et al, 2020, Metabolomics should be deployed in the identification and characterization of gene-edited crops, The Plant Journal).
(3.3) Trait-based technologies: In addition to the OMICs approach, the trait itself can be an indication that the product is derived from NGT. This method has been applied in the past to identify cell fusion based cytoplasmic male sterility (CMS) by cultivating and testing if the flowers produce sterile pollen. This requires an up to date database of products derived from NGT already on the market (see above).

* **8. Are your members taking specific measures for NGT-products to ensure the compliance with the labelling requirements of the GMO legislation?**

- ○ Yes
- ○ No
- ◉ Not applicable

* Please explain why not

The organic sector does not produce products that are to be labelled as GMO.

* **9. Do you have other experience or knowledge that you can share on the application of the GMO legislation, including experimental releases (such as field trials or clinical trials), concerning NGTs/NGT-products ?**

- ○ Yes
- ○ No
- ◉ Not applicable

Please upload any supporting documentation for this section here. For each document, please indicate which question it is complementing

The maximum file size is 1 MB

B - Information on research on NGTs/NGT-products

* **10. Are your members carrying out NGT-related research in your sector?**

- ○ Yes
- ◉ No
- ○ Not applicable

* Please explain why not

The priorities of organic breeding activities are set on breeding pathways that enhance resilience at the farm system level, taking into account the holistic dimension of organic systems, developing novel breeding concepts that combine participatory approaches with modern breeding tools (that are compatible with the organic principles). Exciting scientific discoveries on the complex interface of the plant not only with the abiotic environment but also with the living microbiome in and around the plant are analysed for their potential exploitation in breeding programs for organic and low input breeding.

For the organic sector, there is a need to better understand the concept of resilience and how that can be transformed into breeding objectives. One objective is to develop plant traits for improved resilience. Improved disease resistance as well as the relationship between yield, resilience and product quality are issues that further research is needed on. Combining these different traits in new varieties for organic agriculture is one of the biggest challenges in breeding. Another objective is to develop new breeding strategies based on more diversity such as the so-called Composite Cross Populations and variety mixtures.

* **11. Are you aware of other NGT-related research in your sector?**

- ○ Yes
- ○ No
- ◉ Not applicable

* **12. Has there been any immediate impact on NGT-related research in your sector following the Court of Justice of the EU ruling on mutagenesis?**

Court of Justice ruling: Case C-528/16 http://curia.europa.eu/juris/documents.jsf?num=C-528/16

- ○ Yes
- ○ No
- ◉ Not applicable

* **13. Could NGT-related research bring benefits/opportunities to your sector/field of interest?**

- ◉ Yes
- ○ No
- ○ Not applicable

* Please provide concrete examples/data

The organic food and farming sector does not expect that NGT-related research will bring benefits to the agriculture sector overall. Rather, research priorities should be on the design of agricultural systems that incorporate agro-ecological concepts building upon natural systems rather than intensifying external -inputs. On the other hand, research into unintended modifications at the target site (on-target modifications) and in proximity to the target site (off-target modifications) is crucial to get a better understanding of the potential side-effects of applying the technology. This knowledge could also feed into the development of detection methods and strategies that could be used to trace the presence of products of NGT in food, feed and the environment (please see answer to question 7). Only with an improved understanding of the technology, its potential side-effects, the plant genome and metabolic pathways, the full impact of the technology can be assessed.

* **14. Is NGT-related research facing challenges in your sector/field of interest?**

- ○ Yes
- ○ No
- ◉ Not applicable

* **15. Have you identified any NGT-related research needs/gaps?**

- ◉ Yes
- ○ No
- ○ Not applicable

* Please specify which needs/gaps, explain the reasoning and how these needs/gaps could be addressed

Introducing small changes to the genome or gene regulation with the help of NGTs can be connected with the intervention in complex metabolic pathways and food web mechanisms (Karageorgi et al., 2019, Genome editing retraces the evolution of toxin resistance in the monarch butterfly; Sanchez-Leon et al., 2018, Low-gluten, nontransgenic wheat engineered with CRISPR/Cas9). More research is needed on these complex interactions before these organisms are introduced into the environment, in line with the precautionary principle. Research into unintended modifications at the target site (on-target modifications) and in proximity to the target site (off-target modifications) is crucial to get a better understanding of the potential side-effects of applying the technology. Only with an improved understanding of the technology, it's potential side-effects, the plant genome and metabolic pathways, the full impact of the technology can be assessed.

Research on detection methods/strategies for NGTs will be crucial to enable traceability for the benefit of the agri-food chain and consumer choice. The Commission should therefore fund a research programme to develop proof of concept of the ability to identify & trace all products from NGT. The programme should investigate, but not limit itself to:

(1) Screening methods that harness the error prone nature of Non-homologous end joining (NHEJ) which typically introduces mutations at the repair sites. This feature allows to detect organisms in which no mutation has been introduced by Crispr/Cas systems at a specific site in the genome as described by Guo J. et al (2018, A simple and cost-effective method for screening of Crispr/Cas9-induced homozygous/biallelic mutants).
(2) Exploring detection methods & strategies based on the capabilities of genome editing that are inter alia Alteration of multiple, identical DNA sequences, Multiplexing (alteration of multiple, different DNA-sequences) and the alteration of protected parts of the genome (normally protected by DNA Mismatch Repair).
(3) Exploring the potential of Next Generation Sequencing and bioinformatics-based methods & strategies for simultaneous detection of (multiple) genome edited events as well as 'omics'-techniques. Bioinformatic tools and special software can be used to predict genomic target sites as well as unbiased whole genome screens to detect unwanted off-target effects (Eckersdorfer et al., 2019, An EU perspective on biosafety considerations for plants developed by genome editing and other new genetic modification techniques).

Please also see answers to question 7 for a detailed description of potential detection methods.

Please upload any supporting documentation for this section here. For each document, please indicate which question it is complementing

The maximum file size is 1 MB

C - Information on potential opportunities and benefits of NGTs/NGT-products

*** 16. Could NGTs/NGT-products bring benefits/opportunities to your sector/field of interest?**

- ○ Yes
- ◉ No

* Please explain why not

Potential benefits and opportunities are largely hypothetical at the moment and therefore difficult to assess. Moreover, benefits that may appear in one farming model (e.g. large-scale monocultures) may not appear in others, or may lead to trade-offs (e.g. herbicide tolerance versus increased use of herbicides, or apparition of resistant weeds). Lastly, potential benefits should always be assessed in comparison to alternative technologies or practices.

* **17. Could NGTs/NGT-products bring benefits/opportunities to society in general such as for the environment, human, animal and plant health, consumers, animal welfare, as well as social and economic benefits?**

- ○ Yes
- ◉ No

* Please explain why not

Potential benefits and opportunities are largely hypothetical at the moment and therefore difficult to assess. Moreover, potential benefits should always be assessed in comparison to alternative technologies or research pathways.

* **18. Do you see particular opportunities for SMEs/small scale operators to access markets with their NGTs/NGT-products?**

- ○ Yes
- ◉ No

* Please explain why not

Small-and medium sized breeding companies are in a difficult position to compete with the market power of those few operators that control a major part of the seed market (https://philhowardnet.files.wordpress.com/2018/12/Seed2018-1.pdf). Small operators are severely restricted by patents on plants and patents on NGT-technology itself, like Crispr/Cas. Patents are a major obstacle for small-and medium-sized breeding companies to develop plants and bring them to market independently. The necessity to negotiate patent-contracts with large corporations puts small- and medium sized breeding companies in a difficult situation, and license fees are a financial burden. Therefore, products that are developed by SMEs are consequently sold often to large scale operators to exploit the product commercially, which inhibits the emergence of SMEs on the market.

* **19. Do you see benefits/opportunities from patenting or accessing patented NGTs/NGT-products?**

- ○ Yes
- ◉ No

* Please explain why not

The exchange of plant genetic material is essential for plant breeding. Farmers constantly need new varieties, as growing conditions on the fields and market demands change rapidly. Climate change makes it even more urgent for farmers to have access to a wide range of adapted varieties. Patents on seeds hinder the development of new varieties as they limit the access to genetic material that is essential for innovation in breeding. Therefore, seeds and genetic traits that can be found in nature (regardless the technique used, including NGT) or obtained through conventional breeding must not be subject to patenting, also in order to protect farmers from intellectual property rights claims regarding the plants and animals they save and breed on their farm.

Please upload any supporting documentation for this section here. For each document, please indicate which question it is complementing

The maximum file size is 1 MB

D - Information on potential challenges and concerns on NGTs/NGT-products

*** 20. Could NGTs/NGT-products raise challenges/concerns for your sector/field of interest?**

- (●) Yes
- ( ) No

* Please describe and provide concrete examples/data

The organic sector is depending on the traceability of all GMOs, as transparency is the 1st precondition to protect organic markets. Without traceability, organic producers are unable to show that their products are free of GMOs as demanded by the Organic Regulation 834/2007 and expected by consumers.

The potential release of NGT-products into the environment and the food chain is a major challenge for the organic sector and its capability to ensure full compliance with the Organic Regulation. A properly functioning traceability system provides legal security to the actors throughout the chain of production to be able to not use GMOs in the production process. To design the production process accordingly, our members effectively rely on the documentation that is accompanying a product that have been affixed or provided pursuant to Directive 2001/18/EC, Regulation (EC) No 1829/2003 of the European Parliament and of the Council or Regulation (EC) No 1830/2003 of the European Parliament and of the Council (in particular Article 4). However, our members are concerned with the fact that protocols for the detection of NGT-products are not established yet as part of the routine of inspections and controls that take place on the member-state level (specified in 1830/2003, Article 9). Consequently, control measures cannot guarantee the proper declaration of imports from non-EU countries and might result in fraud and the import of unauthorized GMOs into the EU market. Insufficiently transmitted information from operators could lead to unintentional presence of (unauthorized) NGT-products in organic products. This, in turn, would have a severe economic impact for the farming & food processing sectors. Organic products, for example, lose the organic certificate (& premium) if they must be labelled containing GMOs (EC 834/2007). This means in practice that they could not be sold on the EU market as food anymore due to consumer rejection of GMO products, which implies a major economic loss. In addition, contamination leads to a severe loss in consumer trust into the integrity organic products (for example, 81% of German consumers indicate that the absence of GMOs is one of the reasons to consume organic (BMEL, 2019, Oekobarometer)).

Another challenge relates to the prospect of NGT-products being cultivated in areas were organic agriculture is practiced. In practice, “coexistence” is not always possible and is associated with high costs for organic operators as a study on the socio-economic impacts of GMOs on European Agriculture (published by IFOAM EU and FiBL in 2017) shows. While these costs were calculated for GMOs that were on the market pre-2017, costs for avoiding contamination with NGTs are likely to be applicable within comparable limits. For organic farmers, processors and traders it will be impossible to trace and detect all potential contaminations by products of NGTs, if the number of products increases which are derived from NGT and if applied in many different crop species.

Please see the answer to question 4 for more detailed information on the associated costs.

* Are these challenges/concerns specific to NGTs/NGT-products?

- ○ Yes
- ◉ No

* Please explain why not

Challenges/concerns regarding traceability relate particularly to NGT-products for which traceability has not been enforced/established yet. However, in general, preventing the contamination of organic products is not an issue that is specific to NGT-products but a challenge for the organic and GMO-free sector that relates to all GMOs.

*

21. Could NGTs/NGT-products raise challenges/concerns for society in general such as for the environment, human, animal and plant health, consumers, animal welfare, as well as social and economic challenges?

- (●) Yes
- ( ) No

* Please describe and provide concrete examples/data

NGTs raise particular concerns regarding ethics and animal welfare if applied in the context of genetically modified farm animals. This will concern animals that are subject to livestock husbandry and aquaculture in particular. However, there are potentially indirect consequences for insects and other wild animals if organisms are released into the environment. The example of the genome-edited cattle that was modified to be hornless illustrates the animal welfare dimension of genome editing. While there is a certain logic to breeding hornless cattle and thereby reduce the risk of injury in a close confinement situation, such uses of genome editing would enable even greater intensification of farming and allow to keep animals at a higher density. In this context, one has to acknowledge the negative impacts on animal welfare that are associated with this type of animal husbandry. This also extends to humans with the increase in zoonotic diseases as a result of intensification of production (Jones B. et al., 2013, Zoonosis emergence linked to agricultural intensification and environmental change, PNAS 110 (21)). This applies for many possible applications of NGTs, such as the stimulation of increased muscle growth which could lead to increased rates of Caesarean section, leg problems or breathing complications (De Graeff N et al., 2018, The ethics of genome editing in non-human animals: a systematic review of reasons reported in the academic literature. Philosophical Transactions B 374. p. 6). Finally, the organic movement believes that animals as well as plants and humans have an intrinsic value that should be respected, also in the light of prospective human benefits.

In cooperation with FiBL, IFOAM EU has conducted two meta-analyses on the economic benefits of GM corps. Several studies took a broader perspective by considering the economic impacts of compliance with coexistence rules and cleaning of machinery (p.9). Bullock and Desquilbet (2002) estimated cleaning costs at farm level. While the estimation was made for transgenic GMOs, the costs are very likely to be equal considering the comparable nature of the processes involved to clean a planter/harvester. According to a study from Areal and Copeland (2005), coexistence of GM and organic winter oilseed rape would result in additional costs between 8 and 63% of the total income of an organic farmer contrary to 1 to 4% for a conventional farmer. A calculation by Bock et al. (2002) therefore estimated an extra cost for changing agricultural practices, monitoring GMO content and insurance costs of 345EUR/ha for organic oilseed rape production compared to 126EUR/ha for conventional seed production. This shows the high economic burden that organic agriculture is handling to be able to provide a product that is living up to the organic standards. Ensuring coexistence leads to increased prices for the non-GM product of between 7 and 14% (Gabriel & Menrad, 2015). This puts especially small- and medium-sized farmers in a fragile financial situation as they also have to be competitive with regard to production costs . Also, the impacts of patents/IPR as well as market concentration (e.g. in the seed sector) result in dependencies that are often to the disadvantage of (especially smaller-scale) farmers. In this context, products of NGTs also have the potential to further increase the risk/reward imbalance between farmers and retailers. Please see further elaboration on economic challenges for the economic sector in the answer to question 4.

Please see the elaborations on environmental & human safety in the answers to question 24.

* Under which conditions do you consider this would be the case?

In general, challenges arise especially if GMOs would be released into the environment without risk assessment, traceability and labelling. In other words: if the current GMO legislation would be weakened. In

such a scenario, NGT-products would not be traceable anymore in the environment and the chain of production, with obvious negative consequences for environmental & human safety, the organic and GMO-free sector as well as for the freedom of choice for consumers.

* Are these challenges/concerns specific to NGTs/products obtained by NGTs?
  - (•) Yes
  - ( ) No

* Please explain

NGTs raise particular concerns regarding the capacity to effectively monitor potential adverse outcomes through post-market surveillance as long as no effective traceability mechanism as well as detection strategies/methods are implemented at the EU level.

* **22. Do you see particular challenges for SMEs/small scale operators to access markets with their NGTs /NGT-products?**
  - (•) Yes
  - ( ) No

* Please explain and provide concrete examples and data

Small operators are severely restricted by patents on plants and patents on NGT-technology itself. The patenting and licencing landscape (https://www.labiotech.eu/features/crispr-patent-dispute-licensing/) for NGT applications is limiting the access to the technology for small players that have restricted means to negotiate the terms for the application of e.g. Crispr/Cas technology. Patents are a major obstacle for small- and medium-sized breeding companies to develop plants and bring them to market. The necessity to negotiate patent-contracts with large corporations puts small- and medium sized breeding companies in a difficult situation, and license fees are a financial burden. In addition, concentration in the seed market (https://philhowardnet.files.wordpress.com/2018/12/Seed2018-1.pdf) among a few players (ChemChina-Syngenta, Bayer-Monsanto, Corteva, BASF) makes it very difficult for SMEs to establish themselves as an independent player in the market and leads to high rates of external takeovers.

* **23. Do you see challenges/concerns from patenting or accessing patented NGTs/NGT-products?**
  - (•) Yes
  - ( ) No

* Please describe and provide concrete examples/data

NGT products that are engineered to be similar to products of conventional breeding might raise issues regarding the farmer's rights to save and reproduce seeds and to breed animals, given the patentability of the products of new genomic techniques. The farmer's privilege is internalized in Art 14(1) Council regulation (EC) 2100/94: 'for the purposes of safeguarding agricultural production, farmers are authorized to use for propagating purposes in the field, on their own holding the product of the harvest which they have obtained by planting, on their own holding, propagating material of a variety other than a hybrid or synthetic variety, which is covered by a Community plant variety right'. Therefore, seeds and genetic traits that can be found in nature (regardless the technique used, including NGT) or obtained through conventional breeding must not be subject to patenting, also in order to protect farmers from intellectual property rights claims regarding the plants and animals they save and breed.

In addition, the exchange of plant genetic material is essential for plant breeding. The breeder's exemption is a unique and key feature of the plant variety right system that ensures the safeguard of free access to protected varieties for further breeding and commercialisation. The resulting variety can be protected and commercialised without any obligation towards the right holder of the protected variety (https://www.iprhelpdesk.eu/sites/default/files/newsdocuments/Fact-Sheet-Plant-variety-protection_0.pdf). Farmers constantly need new varieties, as growing conditions on the fields and market demands change rapidly. Climate change makes it even more urgent for farmers to have access to a wide range of adapted varieties. Patents on seeds hinder the development of new varieties as they limit the access to genetic material that is essential for innovation in breeding.

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E - Safety of NGTs/NGT-products

*** 24. What is your view on the safety of NGTs/NGT-products? Please substantiate your reply**

IFOAM and its members has far-reaching concerns regarding the safety of NGT products. At an abstract level, this is connected with the fact NGTs facilitate targeted interventions that are taking place beyond the cell-level and therefore go beyond natural crossing barriers. These kind of targeted changes in the genome sequence potentially have unwanted side-effects on human & plant health, the environment as well as biodiversity. Given the complex interactions within ecosystems, IFOAM is a vocal supporter of the precautionary approach regarding all forms of genetic engineering in the spirit of respecting our genetic heritage and planetary biodiversity.

It is important to be aware that the characteristics of some genome editing applications (e.g. small extent of genomic sequence change and their higher targeting efficiency) cannot be considered an indication of safety per se. Unintended effects that require special risk assessment considerations include, among others: (1) the introduction of unintended molecular changes that lead to unintended effects on physiology, development or composition with implications for food, feed and environmental safety, (2) introduction of changes that modify the expression of endogenous genes and impact the organisms metabolism, (3) introduction of transgenic constructs that are present during intermediate steps that might not be fully removed and absent from the final product (Eckersdorfer et al., 2019, An EU perspective on biosafety considerations for plants developed by genome editing and other new genetic modification techniques, Front. Bioeng. Biotechnol. 7:31).

Both so-called on-target and off-target effects have potential safety implications. On-target effects describe unanticipated and unintended repair products at the target site, created by gene-editing tools (Sansbury M., Hewes, A., Kmiec, E., 2019, Understanding the diversity of genetic outcomes from CRISPR-Cas generated homology-directed repair, Communications Biology (2) 458). Rearrangements caused by genome editing include insertions, deletions, inversions or translocations. What is worrying from a safety perspective is that integration errors are currently often under reported or overlooked (Lombardi H. et al., 2020, Template plasmid integration in germline genome-edited cattle, Nature Biotechnology 38, pp. 163-164.)
. Off-target effects describe unanticipated and unintended repair products that are not located at the target site. In general, off-target effects can occur with all types of GMOs, however there are specific off-target effects that are associated with NGTs. These types of errors have been reported with ZFN and Crispr/Cas,

which are the most prominent NGTs. Even though detection of off-target effects is not sufficiently developed yet, off-target effects have been identified (Modrzejewski D. et al., 2019). This highlights that a thorough risk-assessment is crucial to prevent potentially harmful impacts on the environment, biodiversity and human health. Next to those on-&off-target effects, that are structural problems associated with NGTs, there is also the issue of intermediate transgenic steps being applied to introduce the gene editing tool into the cell. In this step, a plasmid (DNA-ring) is often introduced into the cell that contains the sequence information for the Crispr/Cas construct or TALENs. In the case of a genome-edited cattle, a full-length plasmid backbone that contained an antibiotic resistance gene (AmpR) remained in the genome of the bull and would have expected to inherit the bacteria genes to its offspring as it was integrated in the germline of the calves (Lombardi H. et al., 2020). The unintended addition of DNA was only detected because the FDA (US Food and Drug Administration) had a closer look at the whole genome sequence of the genome edited animals. The lesson learned from this incident is that errors like these could go unnoticed if NGTs would be deregulated and a thorough risk assessment by government bodies is crucial to detect those errors and protect the safety of animals, the environment and consumers. The FDA scientists conclude that gene-editing errors are either under-reported or overlooked and often a blind spot for standard genome-editing screening methods (Lombardi H. et al., 2020).

Additional considerations relate to traits such as herbicide resistance (HT). NGTs can be used to produce herbicide resistant crops such as the Cibus oilseed rape. NGTs are powerful tools for the targeted introduction of multiple herbicide resistance genes via SDN-2 and SDN-3 applications. Apart from the known safety risks of HT-tolerant crops such as weed resistance and excessive use of pesticides, organisms that provide multiple resistances can be expected to lead to food products that contain ‘cocktail mixes’ of pesticide residues (Eckersdorfer et al., 2019).

*** 25. Do you have specific safety considerations on NGTs/NGT-products?**

- (●) Yes
- ( ) No

* Please explain

Specific safety considerations are, next to off-target and on-target effects (see answer to question 24), relating to the depth of intervention that is possible with NGTs. One of those new possibilities that came up with NGT (including SDN-1 applications) is multiplexing, which describes the simultaneous introduction of modifications into (i) multiple alleles, (ii) all members of a gene family or (iii) different functional genes (Eckersdorfer et al., 2019). These applications can result in substantial metabolic reprogramming. Sufficient molecular and phenotypic characterization will be required to assess the effects of these genetic modifications on physiological functions.

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F - Ethical aspects of NGTs/NGT-products

*** 26. What is your view on ethical aspects related to NGTs/NGT-products? Please substantiate your reply**

From a holistic view, the organic sector embraces the partner attitude towards nature which includes that not only humans and animals but all living entities, including plants, are considered ethically relevant out of respect for the integrity of life, referring not only to an extrinsic value (usefulness for mankind) but also to a perceived intrinsic value of living organisms (worth as a living entity as such based on respect for their “otherness”, dignity, wholeness and autonomy). This respect for the integrity of life implies that intervention in nature is not absolutely prohibited in organic farming – rather that it should be used as a positive cultural enhancement. In this context, the cell is respected as a functional entity and technical/physical invasion into an isolated cell on growth media is refrained from (e. g. digestion of the cell wall, destruction of the cell nucleus through cytoplast fusions).

*** 27. Do you have specific ethical considerations on NGTs/NGT-products?**

- (●) Yes
- ( ) No

* Please explain

Products from NGTs are not compliant with these aforementioned principles of organic breeding. In vitro, ex vivo, or in vivo nucleic acid techniques, as well as editing and modifying DNA, RNA, or any other molecules in the cells are considered to be an invasion into the genome and cell. Induced chromosome breakages disrupt the integrity of the genome.

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G - Consumers' right for information/freedom of choice

*** 28. What is your view on the labelling of NGT-products? Please substantiate your reply**

Labelling is the precondition for freedom of choice for consumers, this is why a legally binding obligation to disclose the applied breeding method is essential. A harmonised labelling scheme, as it is currently prescribed in the context of Regulation 1830/2003 ensures this freedom of choice and also contributes to the effective functioning of the internal market. Consumers are reflecting increasingly about their food choices and labelling schemes are an essential indicator for consumers to make a well-educated choice.

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H - Final question

*** 29. Do you have other comments you would like to make?**

- ( ) Yes
- (●) No

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