Here are the facts about

Agriculture and Nutrition

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Dear reader,

Agriculture and nutrition affect us all and connect with people on a deeply emotional level. Food quality, crop protection, a changing climate, environmental protection and the safeguarding of farmers' existences are all issues that can lead to a clash of different opinions.

Recently, there has been increased media attention on the safety of some agricultural products. As a science and innovation company, we feel a deep responsibility – to consumers and our planet – and want to reiterate our commitment to sound science and the safe use of the products and technologies farmers use to protect their harvests and ensure enough high quality, safe and affordable food for all.

The future of our planet depends on the ability of agriculture to not only increase productivity, but to do this in a sustainable manner that is respectful of our limited natural resources and need for biodiversity. We should be having a conversation on the best ways to achieve these two objectives in a more holistic manner.

Before any conversation starts, we believe it is helpful to outline the facts according to independent sources and then have a more objective discussion. This brochure addresses many critical questions that are often posed to the agricultural industry. And we provide you with our views on these topics along with relevant independent scientific findings to support those views. You may have a different view and we would be very interested in hearing why, so please don't hesitate to contact us at yourquestions@bayer.com. We look forward to the dialog with you and hope you find this brochure interesting.

Sincerely,

Liam Condon
Member of the Board of Management of Bayer AG
and President of the Crop Science Division

Why do farmers need pesticides?

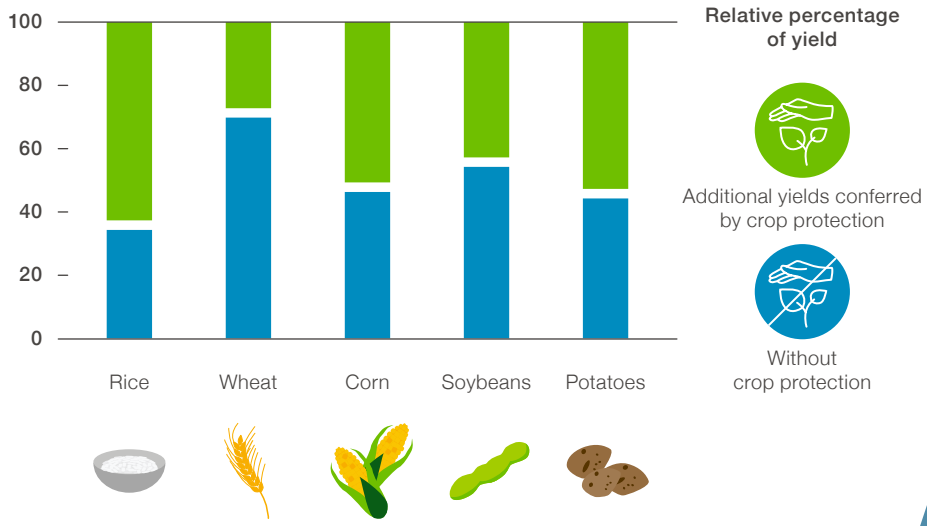
Every farmer must protect his or her crops against diseases, pests and weeds – just as they must protect farm animals against diseases and parasites. People, too, take medicines to keep us healthy.

Crop protection solutions help farmers produce more food on less land to help meet rising demand, while also preserving vital natural resources. A farmer's crop may compete with up to 30,000 different weeds, 10,000 species of insect pests, 3,000 types of nematodes, and 50,000 plant diseases caused by bacteria, fungi and viruses.[1] This task is not easy. For example, plant-infesting fungi and their toxins can be detrimental to our health if we don't fight them.

Globally, farmers lose 30 to 40 percent of their crops because of pests and diseases.[2] With the world expected to exceed 9 billion people by 2050, farmers need effective tools that can help them grow more food, even as the amount of farmland per capita continues to shrink.

CROP PROTECTION PRODUCTS SAFEGUARD HARVEST YIELDS.

Disease pathogens, pests and weeds represent a significant threat to major field crops.



Source: Oerke, Bonn University, in Journal of Agricultural Sciences 144/2006

How is the safety of pesticides ensured?

The registration of crop protection products is designed to protect human health and the environment.

Regulatory agencies require nearly 100 safety studies before allowing a product to be placed on the market. All studies submitted to a regulatory agency are conducted according to internationally recognized standards (Good Laboratory Practices) and audited, which ensures that the tests are conducted properly and the results are reliable. Major regulatory agencies around the world – including the U.S. EPA and the European Food Safety Authority – review all of the safety data required for registration to conclude products can be used safely when label directions are followed. Products are then regularly re-evaluated with the latest data and scientific knowledge to ensure continued safe use.

Furthermore, Bayer is committed to transparency in the field of crop protection and is a pioneer in the industry in this respect. Bayer's transparency website (www.cropscience-transparency.bayer.com) provides access to scientific data used in the assessment of crop protection products and makes the safety data that were previously available only to regulatory authorities publicly accessible.

As usual, the burden of proof lies with the company.

As with the approval processes for pharmaceuticals, vehicles, airplanes and other products, the burden of proof rests with the applicant – in other words the company that produces the product and intends to introduce it to the market. These companies therefore have to conduct comprehensive toxicological studies to prove the crop protection product's safety for every use pattern, and the active substances in crop protection products are some of the most scrupulously examined substances in the world.

Is glyphosate safe?

Glyphosate is the most studied herbicide in the world. More than 800 scientific studies, the U.S. EPA, the European Food Safety Authority, the European Chemicals Agency and the German BfR, among others, have found that glyphosate is safe when used as directed.

It is important to know that glyphosate blocks a specific enzyme pathway that is essential for plant growth but is not found in human or animal cells. In December 2017, the U.S. EPA again confirmed that glyphosate is “not likely to be carcinogenic to humans,” which is the EPA’s most favorable classification, and also confirmed that glyphosate poses no other meaningful risks to human health when used according to its label.

Glyphosate has a very high degradation rate – and not just in the soil. Minimal residues of the substance that analyses have detected are also eliminated quickly from the body through the kidneys.

Why is glyphosate so important?

Just like other companies, farmers must be economically viable. That is why they have to efficiently control weeds, protect their crops and treat well their most important capital – the soil. Weeds cause problems in farm fields because they steal water, sunlight, and nutrients from the crops farmers are working hard to grow. Glyphosate was a breakthrough when introduced 40 years ago and is the most widely used herbicide in the world because of its effectiveness, environmental benefits, and safety profile. One study found that without glyphosate, yields in the EU of rapeseed, barley, wheat, and maize could reduce by 22 percent.[3]

The use of glyphosate is environmentally friendly

Glyphosate enables farming practices that have ecological and carbon footprint benefits such as reduced- or no-till farming, a practice that reduces soil erosion, promotes soil health and helps reduce CO_2 emissions. Without glyphosate, globally, "there would be additional carbon emissions arising from increased fuel usage and decreased soil carbon sequestration, equal to the equivalent of adding 11.77 million cars to the roads.[4]

Does glyphosate cause cancer?

In March 2015, the International Agency for Research on Cancer (IARC), a specialist agency of the World Health Organization (WHO), classified glyphosate as "probably carcinogenic". IARC is one of four programs within WHO that has reviewed glyphosate, and the only one to have made such a finding. Regulatory authorities around the world have all reached conclusions contrary to this one outlier IARC report. Since the IARC report regulatory authorities in the United States, Europe, Canada, Korea, Japan, New Zealand and Australia have publicly reaffirmed that glyphosate-based products are safe when used as directed and that glyphosate is not carcinogenic. Additionally, in May 2016, the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) concluded that "glyphosate is unlikely to pose a carcinogenic risk to humans from exposure through the diet."

In the Agricultural Health Study, researchers from governmental institutes in the United States examined some 50,000 crop protection product users, agricultural workers and their partners over a 20-year period, including about 45,000 who regularly worked with glyphosate. No link was found between the proper use of glyphosate-based herbicides and non-Hodgkin lymphoma.[5]

Classified in the same category as hot tea

It is important to know what the category "2A: probably carcinogenic" actually means. It means that some evidence of an elevated potential of harm exists, but that researchers cannot rule out the possibility that cancer cases could also be attributed to other factors. It must also be kept in mind here that these potential links always involved exposure to glyphosate that farmers experienced on the

job, and not, for example, the consumption of small quantities through food. Next to glyphosate, the IARC lists a number of other things in the same category (“2A: probably carcinogenic”) – hot beverages heated above 65° Celsius, red meat, shift work and the hairdressing profession.

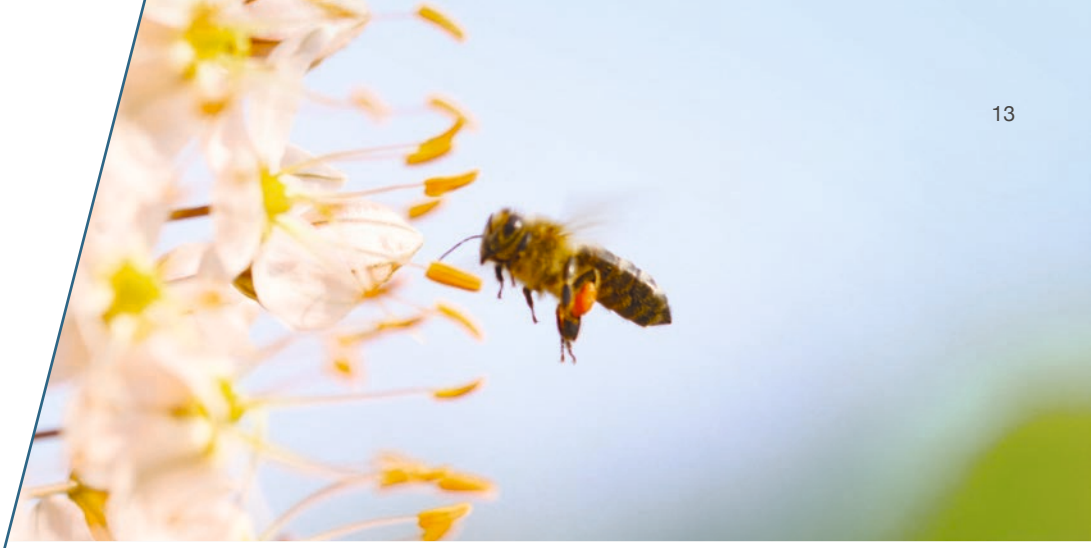
The IARC assesses only the fundamental potential of harm that may be posed by a substance, and not the probability with which such an event could occur.

Does glyphosate harm insects?

Critics like to label glyphosate as a “species killer” that wipes out the plants insects need to live. This process reduces biodiversity, they argue.

Glyphosate blocks a specific enzyme pathway that is essential for plant growth but is not found in human or animal cells. Bayer is not aware of any studies that prove a harmful effect of glyphosate on insects or other animals.

The fact is: glyphosate is a so-called broad-spectrum herbicide. This means it combats all weeds that come in



contact with it, unless the plants have been genetically engineered to tolerate glyphosate. But it is also true to say that the herbicide is mainly applied in areas that are used for agriculture, i.e. in fields that do not primarily serve as habitat and source of food for beneficial insects such as pollinators. Fields where wheat, soybeans or corn are grown cannot at the same time be flowering meadows that provide food to insects. This principle has applied from the very beginning and has nothing to do with the discussion about glyphosate.

Why is glyphosate found in food? Is it dangerous?

In recent years, reports about traces of glyphosate that were found in food or beverages like baked goods, beer and oat flakes have frequently appeared. This has nothing to do with farmers becoming careless in their application of glyphosate. Rather, the increased discoveries of the substance can be traced back to the enormous technical progress that has been achieved in analytical technology. It is now analytically possible to measure even a fraction of a sugar cube in a body of water the size of Lake Constance (Germany).

This is possibly why critics of glyphosate rarely cite specific totals when they discuss the residues of glyphosate found in foods. These totals are usually measured at the microgram level, that is, one millionth of a gram or 0.000001 gram. Glyphosate has a lower toxicity level than cooking salt or baking powder and such concentrations therefore pose absolutely no risk to people’s health. There is no reliable scientific evidence that glyphosate use results in levels of residue that pose health problems for consumers.

How safe is our food?

Consumers around the world can feel comfortable that there are safeguards in place to ensure the food they eat is safe.

Synthetic crop protection agents are meticulously examined prior to their registration in time-consuming studies. They are only approved once it has been ensured that they are safe.

Only in extremely rare cases do checks by the authorities reveal residues of crop protection substances that lie above the legally permitted thresholds. Only 0.9 percent of samples in the E.U. were the subject of complaints as was reported in 2018.[6] And even then it should be pointed out that the legal limits are set at levels far below what could potentially pose risk to people. To present an actual health risk, the residues of crop protection products would have to exceed the permitted maximum limits by a factor of approximately one hundred. In the United States, the Department of Agriculture reported in February 2018 that 0.46 percent of the total samples had residues that exceeded government levels.[7] The Food and Drug Administration (FDA) in October 2018 published results of its annual residue testing program and was clear that the glyphosate levels "were below the tolerance levels set by the U.S. Environmental Protection Agency (EPA)."[8]

Usually natural antigens

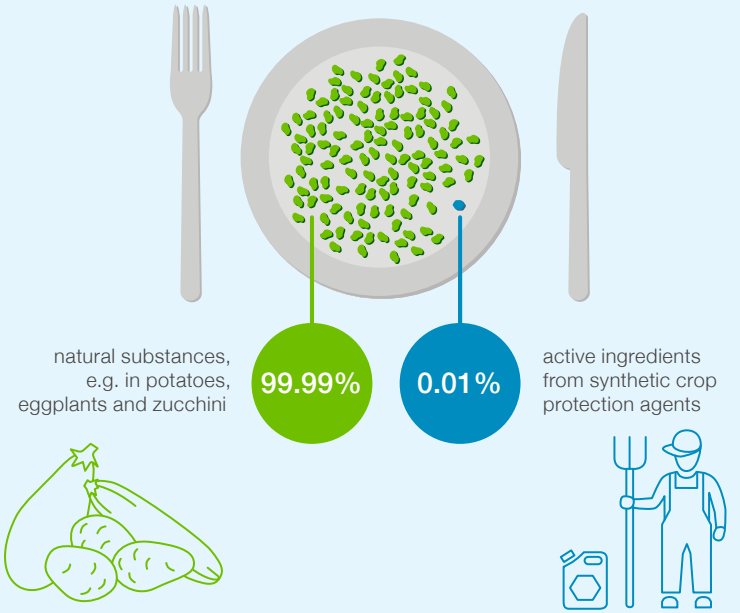
Natural, but potentially toxic substances play a far more important role in food products than synthetic crop protection agents. American biochemist Bruce Ames has calculated that we consume some 1.5 grams of potential "toxins" daily if we maintain a diverse diet with plenty of fruits and vegetables. This corresponds to the weight of between 50 and 60 grains of rice. However, 99.99 percent of these substances are natural in origin.[9] In other words, the plants produce them to protect themselves against pests and other predators: for example, potatoes produce the toxin solanine, zucchini and eggplant produce dangerous bitter substances, and chili peppers produce the neurotoxin capsaicin. While these natural plant toxins make up a weight amounting to 50 to 60 grains of rice, synthetic pesticides by contrast weigh less than half a grain of salt (approximately 0.0015 grams).

Evolution created the liver in humans and animals due to these natural substances. It can easily render most of these toxins harmless – but not all of them: for example, our liver cannot neutralize the poison of the death cap mushroom.

Synthetic crop protection agents are meticulously examined prior to their registration. They are only approved once it has been ensured that they are safe.

ALMOST ALL POTENTIALLY TOXIC SUBSTANCES IN FOOD HAVE NATURAL ORIGINS.

Plants produce many toxins themselves to defend themselves against competitors or pests.



Source: Ames 1990 et al.,Dietary pesticides (99.99% all natural), Medical Sciences, 87-1990

OVERVIEW OF NATURAL AND SYNTHETIC SUBSTANCES

Glyphosate is less toxic than baking powder or cooking salt.

Substance green = “natural substance”	**What is it?**	**LD 50** (mg/kg)*	**Hazard classification**
Sugar	Per person consumption in Germany averages 130 grams per day.	**29,700**	**Not classified as harmful in Europe** > 2,000 mg/kg
Glyphosate	The world’s most frequently used crop protection agent, deployed as a herbicide.	**4,870**	
Baking powder	Useful as a leavening agent in baked goods such as bread, cake or waffles.	**4,090**	
Cooking Salt (NaCl)	Men in Germany consume an average of 10 grams of salt daily, women 8.4 grams.	**3,000**	
Theobromine	An active ingredient with a stimulating effect on the nervous system. It is contained, for instance, in cocoa beans (chocolate).	**1,270**	**Harmful if swallowed** < 300–2,000 mg/kg **Warning**
Caffeine	Present as a stimulant in, for example, coffee, tea, cola and energy drinks.	**368**	
Copper sulphate	An anti-fungal agent used especially in organic farming	**300**	**Toxic if swallowed** < 50–300 mg/kg **Danger**
Nicotine	A substance that is formed in the roots of the tobacco plant	**50**	**Fatal if swallowed** < 5–50 mg/kg **Danger**
Aflatoxin**	A fungal toxin. The fungus spreads through hay, for example.	**2.7–4.8**	**Fatal if swallowed** ≤ 5 mg/kg **Danger**

* Standard for determining toxicity: Threshold for 50% mortality in rats
** ThermoFisherScientific, Safety Data Sheet, Revision Date January 19, 2018, Product Name Aflatoxin B1

Source: GESTIS Substance Database

> “Only the dose makes a thing not a poison.”

Paracelsus, 1538

How safe are genetically modified crops?

Genetically modified (GM) foods are subjected to extensive testing before being made available to the public. Since becoming available in 1996, not a single food safety or health issue associated with genetically modified foods has ever been recorded.

In 2016, the National Academies of Science issued perhaps the most comprehensive report on genetically modified crops after reviewing more than 900 studies and consulting with 80 globally recognized experts. This multi-year assessment found no difference in safety between GM crops and their conventional counterparts. In fact, it found that in some cases such as with insect-resistant crops, there was a human safety benefit of GM crops due to reduced pesticide exposure.[10]

This finding has been mirrored by other expert scientific bodies around the world, such as the The Royal Society, the world's oldest independent scientific academy.[11]

Genetic engineering as a modern option

Genetic engineering, which introduces new genes to plants, was developed as a method more than 30 years ago. Today there are 10 GM crops commercially available: corn, cotton, soybeans, canola, alfalfa, sugar beets, papaya, squash, apples, and potatoes.[12]

In 2016, more than 100 Nobel laureates advocated the use of genetic engineering in agriculture.

Already today genetic engineering make plants more resistant to pests or diseases. It can add useful nutrients or vitamins to plants or quite simply enable farmers to produce higher yields. In the future genetic engineering might help plants to cope better with heat, drought, moisture or soil salinity and it may even be conceivable to make plant roots more absorptive to certain nutrients or to substantially improve the storability of food and animal feed.

These traits are of significant importance to global agriculture as the climate is changing the instances of extreme weather increase. What's more, the biotic stress factors affecting plants are changing all the time, too, as new competing weeds, insect pests and plant diseases are spreading. As the development of a commercially viable variety can take 10 and 15 years, breeders must plan quite far in advance.

Genetically modified crops have proven their value

Recently, a new variety of potato was introduced on the market that produces less acrylamide, a cancer-causing substance, when roasted or deep-fried – a clear advantage for consumer health.

Genetically engineered corn cultivated in many countries around the world that is resistant against certain insects offers numerous advantages. It safeguards yields, requires less insecticide application and is affected with fewer of the fungal toxins – also known as mycotoxins – that otherwise appear in crops after insect infestation because fungi develop in the chewed areas. Mycotoxins can be poisonous, trigger allergies or cause cancer.

Another example of the benefits provided by genetic engineering: in the late 1990s a papaya variety developed using genetic engineering saved the Hawaiian papaya industry, which otherwise would have been completely wiped out by the so-called ringspot virus transmitted by aphids.

Hawaiian farmers who today cultivate organic papayas do so with the protection of genetically modified "rainbow" papaya plantations arranged in a circle around them, because the latter prevent the virus from spreading to the organic papayas.[13]

Does genetic engineering result in farmers using more crop protection products?

Some critics claim the cultivation of genetically modified plants has led to significantly greater use of crop protection products. A glance at the facts disproves this general allegation.

A 2014 study by agricultural scientists at the University of Göttingen, Germany, evaluated roughly 150 publications and reports from all over the world investigating the impact of genetically modified soybeans, corn and cotton field crops. These publications included studies by nongovernmental organizations. The researchers came to the conclusion that when compared to farmers growing non-GM crops, on average, farmers using GM crops used 37 percent less crop protection products, but harvested a 22 percent increase in yield. And despite the higher costs for seed, the farmers' profits increased by a 68 percent.[14]

A heavy reduction in the use of crop protection products was particularly noticeable in insect-resistant plants. The positive effects were greatest for farmers in developing countries, who were able to increase their earnings even more significantly than farmers in industrialized countries, such as the United States and Canada.

Is CRISPR/Cas a way of introducing genetic engineering through the back door?

GENOME EDITING

New molecular biology methods enable us to rewrite or modify individual DNA blocks in genetic material more precisely and safely than ever before.

In medicine, these tools could make it possible to cure certain hereditary diseases, and major advances in plant breeding are likewise within reach.

CRISPR/Cas is a genome editing technology whose use in human medicine is raising high hopes that it could potentially be used to cure hereditary diseases. Experts believe that using this technology to breed new plants could likewise deliver major benefits.

What is CRISPR/Cas?

Bacteria can become sick, too – and they are often infected by viruses. The cryptic abbreviation "CRISPR/Cas" describes the tool as part of the natural immune system of bacteria, something that bacteria can use to defend themselves against these infections. Viruses are very small. They aren't even a cell; in principle they are just genetic material (DNA or RNA) that inserts into the genetic material of a bacterium. The bacterium naturally wants to be rid of this – and that's where CRISPR/Cas comes in: it identifies segments in the genetic material that come from viruses, and cuts them out again in a targeted manner.

This is why CRISPR/Cas is often aptly described as "gene scissors." The important thing is that this technology can be used to make specific modifications to the genome of plants.

Not conventional genetic engineering

What gene scissors do is different from what conventional genetic engineering in plant breeding does. With CRISPR/Cas, the location of the genome in which the modification takes place can be precisely controlled. And a particularly important aspect of this method is that foreign genes generally are not introduced to the plant. The aim is generally to switch off genes or specifically "reactivate" traits – for example from wild varieties that have been lost over the course of breeding. The resulting modification is therefore indistinguishable from a conventional breeding breakthrough or a natural mutation. It's just that this method is simpler, faster and more precise, with no impact on the safety of the final crop compared to traditional plant breeding.

What possibilities does CRISPR/Cas offer?

There are many research projects under way at various stages, right up to the first marketing authorizations. Significant examples include projects to achieve improved resistance to fungal infections in rice or wheat, better-tasting tomatoes and the deactivation of allergens in peanuts.[15]

CRISPR/Cas is the most elegant method of genome editing to date – and also the most “democratic.”

////// CRISPR/Cas is cheap and simple. It therefore is also used by universities and institutes that do not have major research budgets.

How should CRISPR/Cas be regulated?

New breeding technologies promote plant diversity as a result of new or optimally adapted crop varieties for all types of agriculture. They increase the availability of the existing genetic diversity, which currently can be used only sparingly.

The result and not the means should count

Academics, industry researchers, regulatory agencies, and the public around the world are actively discussing how these plant breeding tools will be reviewed to ensure their safe and responsible use.

With regard to regulation, we have the same position as, for example, the German Max Planck Society: What should be important is what actually makes its way to consumers and not what technology it is based on.[16]

Why are seeds patented?

From falling poverty levels to increasing life expectancy, many of the positive developments in human life are thanks to technical and medical advances. Patents play an important role in these developments.

Innovations are hugely significant not only for society, but also for science-based companies. They are frequently one of the most important competitive factors.

Patents protect inventors

It often takes many years and the investment of many millions of euros to achieve a breakthrough development. Developing an innovative drug product and breeding a new plant are extremely complex and expensive processes.

To allow companies to continue to pay for the high costs of research and development they need the certainty that they can exclusively market, during a limited time period, their newly developed products. This is enabled by patents that protect the intellectual property of the inventors. Patent protection is accompanied by the publication of the invention. During the period of patent protection the inventor can allow others to use the invention. After patent protection has expired anyone can freely use the invention. In this way technical advances are promoted.

Plants can be patented if they are knowingly changed to have a new trait such as higher yields or resistance to pests or drought. Such innovations can be achieved by gene technologies but are also possible by other technical processes.

Over the past decades, innovations have led to huge efficiency increases in agriculture. For example, from 1961 to 2014, global cereal production increased by 280 percent.[17]

Over the same period, the world population increased to 7.4 billion. And more than 800 million people still suffer from hunger today. Without further significant yield increases, therefore, it will not be possible to feed all the people on the planet in the future.

Does patented seed cause farmers to become dependent on large companies?

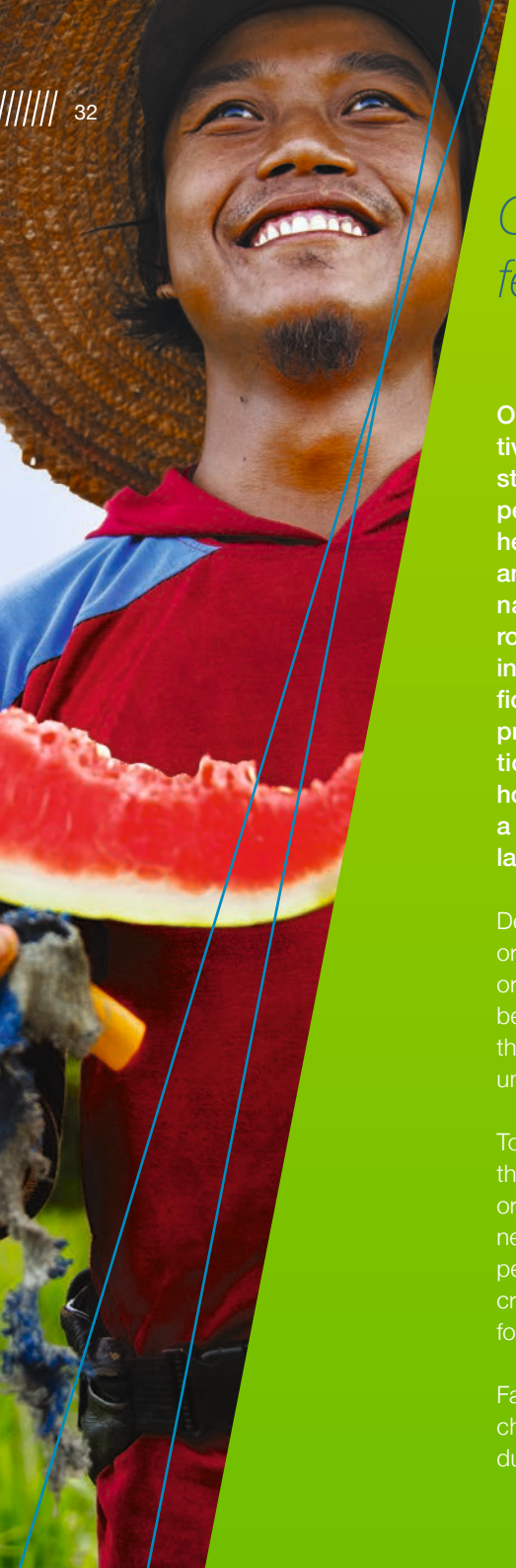
Farmers decide for themselves where they get their seeds from. They can use their own seed or buy it from local suppliers who produce seeds specifically bred to thrive in local conditions. The fact that many farmers nowadays choose the latter option is testimony to higher yields and quality advantages based on decades of research.

Farmers are not forced to buy seed covered by variety or patent protection. They can change seed and use unlicensed seed whenever they choose. The seed selection is extensive. In many developing countries, seed breeding is the domain of public institutions or the farmers themselves. For example, 90–98 percent of farmers in West Africa produce their own seeds; in East and Southern Africa, the figure is 70 to 95 percent.[18]

License fees are customary

If a farmer purchases certified seed, a license fee is included in the price. If he retains part of his harvest and uses this seed for renewed sowing, he must also pay a fee for this. Each year, many farmers often choose to purchase certified seed so that they can benefit from advances in breeding and achieve high yields combined with very good quality. In certain crops such as corn, canola and sugar beet, hybrid varieties are generally used that are more robust and higher-yielding than conventional varieties.

////// In summary, patents have not led to a limitation of available seeds and farmers thus have not become dependent on only a few big companies.



Can organic farming feed the world?

Organic farming relies on objectives and principles such as very strict limits on chemical synthetic pesticide and fertilizer use, soil health, responsible use of energy and natural resources, maintenance of biodiversity, wide crop rotation, growing multiple crops in one field, and the use of beneficial organisms. Many of these practices are adopted in conventional agriculture. On its own, however, it is not suitable to feed a rapidly growing world population.

Depending on the fruit, vegetable or cereal in question, yields of organically produced foods can be between 5% and 34% lower than conventionally grown crops under similar conditions.[19]

To produce enough food to sustain the global population through solely organic methods, more land would need to be used for farming, or more people would be needed to grow crops. These would likely increase food prices globally.

Farmers should have the right to choose and utilize the crop production systems that best suit the needs of their own farm and their customers. As such, organic farming is an option for many farmers and consumers as part of the food industry. That's why Bayer also offers biological crop protections products that can be used in organic farming.

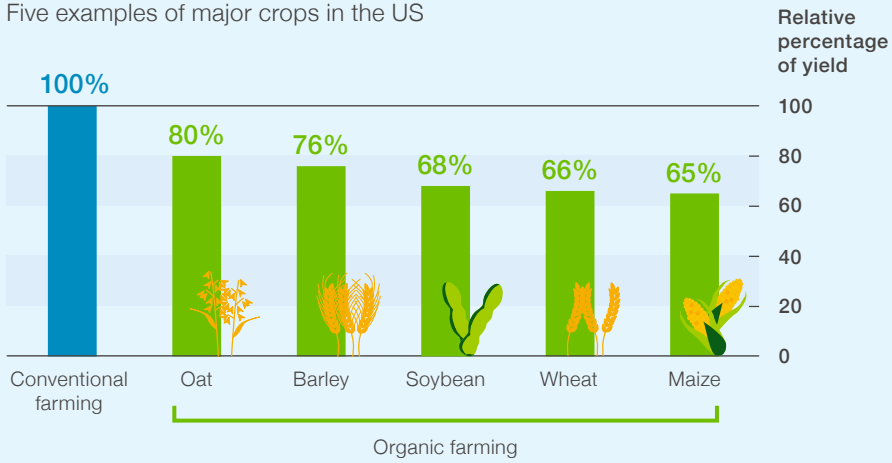
Shift to organic farming came at nature's expense

A study by the University of Göttingen, Germany, examined the impact of organic farming on the environment and climate in various regions of the world. The conclusion: the large-scale expansion of organic farming would generally lead to an additional loss in natural habitat and a decrease in biodiversity. And although it produces lower greenhouse gas emissions than conventional farming per hectare, emissions by yield are higher. What's more, food would become more expensive, which would negatively impact particularly people with low incomes in developing countries.[20]

According to the study, therefore, organic farming is not the model for sustainable agriculture and safeguarding nutrition. In global terms, locally developed and adapted methods combining conventional with organic farming are a better way of helping to sustainably increase productivity.

YIELDS ARE MUCH LESS IN ORGANIC FARMING THAN IN CONVENTIONAL FARMING.

Five examples of major crops in the US



Source: Kniss et al., in Plos One, Aug. 23 / 2016: https://doi.org/10.1371/journal.pone.0161673

How do organic farmers protect their crops from insect pests and diseases?

Organic farmers must also protect their crops against weeds, disease, and insect pests. Specific rules vary by country, however, these farmers are generally not allowed to use substances that are synthesized and therefore regarded as "unnatural." Besides mechanical methods and crop rotation, they use bacteria, beneficial insects, and heavy metal salts, for example.

Whereas some of these techniques are environmentally sustainable, others are harmful both to human health and to ecological systems.

One example is the heavy metal copper, for example, is an essential tool in organic farming to control fungal infections. Not only do copper salts accumulate in soil, they also harm soil organisms – as well as aquatic organisms if they get into the surface water.

The EU regulation on organic farming permits up to 6 kilograms of pure copper per hectare and year.[21] According to U.S. regulations, "copper-based materials must be used in a manner that minimizes accumulation in the soil and shall not be used as herbicides".[22]

Do crop protection products threaten biodiversity?

Crop protection chemicals are thoroughly tested and regularly re-assessed to make sure they can be safely used to keep crops healthy without harming people or the environment.

Changes to biodiversity are complex, but it is important to note that any human interventions into nature can have an effect on biodiversity.

The construction of buildings and roads, the planting of gardens and many other human activities alter habitats and could have a negative effect on biodiversity. Whenever crops are cultivated, irrespective of whether the methods are organic or conventional in nature, plant diversity changes and thus impacts biodiversity. In areas where corn or cereal grows, there are fewer trees, bushes or wild flowers.

For example, in the tropics, biodiversity is concentrated in rain forests; in central Europe, on the other hand, it centers on the diversity of habitats: open landscapes, gravel areas, rough grasslands, heaths, marshes and many more. All of these biotopes have receded in the past decades due to human activity.

Protecting biodiversity

To preserve as many such areas as possible, the productive use of farmland must be maximized.

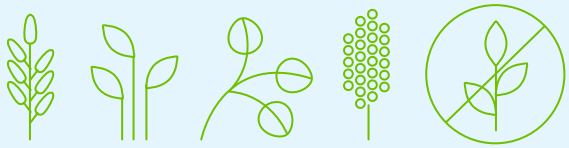
Farmers therefore no longer remove unwanted plants from their fields mechanically but instead now rely on crop protection agents.

Municipalities can also make a positive contribution by cultivating blossoming plants on waysides and traffic islands. Last but not least, ordinary citizens can do a service to nature by designing their gardens in a more colorful and thus more insect-friendly way.

BIODIVERSITY IS DECLINING.

27,000

animal and plant species are lost globally every year.



One in five plant species is at risk of **extinction**.

Source: UNCCD 2016, Kew Foundation 2016

The agriculture quiz

1. What percent of the earth's entire surface is available for the cultivation of crops for human nutrition?

☐ 56% ☐ 13% ☐ 3%

2. How accurate is the analysis technology for measuring pesticide residues? It can identify…?

☐ 1 kilogram of sugar in Lake Constance
☐ 1 cube of sugar in Lake Constance
☐ a fragment of a cube of sugar in Lake Constance

3. What is the oldest known vegetable containing foreign genes?

☐ Tomato ☐ Sweet potato ☐ Potato

4. Glyphosate is less toxic to people than…?

☐ Nicotine
☐ Baking powder
☐ Cooking salt

5. How many risks to the environment or consumer health have scientists found after analyzing nearly 1,800 studies on the effects of genetically modified crops?

☐ 0 ☐ 4 ☐ 18

1. Nearly three quarters of the earth is covered with water. 11% of the earth's surface is covered by areas in which farming is not possible (roads, houses, wasteland, deserts, and mountains). 8% is covered by forests and 7% by pastures. This leaves just 3% of the earth's surface that is available for the cultivation of cereals, fruit or vegetables. Source: Raschka 2012, Nova Institute

2. Modern analysis methods are able to identify ever-smaller concentrations as chemical substances. They are even able to identify a fragment of a cube of sugar in Lake Constance, which has a volume of 48 km3
Source: German Federal Institute for Risk Assessment

3. French fries made of sweet potatoes are a trendy food – and sweet potatoes are the first (verified) natural vegetable that contains foreign genes. Sweet potatoes contain so-called transfer DNA (T-DNA) of the foreign species Agrobacterium, and foreign gene products have also been identified. The transfer took place about 8,000 years ago – without human intervention.

4. Nicotine, cooking salt and even baking powder are more toxic to humans than glyphosate (see page 16).
Source: GESTIS Substance Database. Information system on hazardous substances of the German Social Accident Insurance

5. Despite extremely intensive analyses, there still is no scientific evidence whatsoever that genetically modified crops could have a harmful effect on human health or the environment. By contrast, their main benefits – such as resistance against diseases and pathogens – have been amply documented.

Sources

1 https://croplife.org/news/why-we-need-crop-protection-products/

2 http://www.fao.org/docrep/014/i2215e/i2215e.pdf

3 http://www.ecpa.eu/reports_infographics/cumulative-agronomic-and-economic-impact-glyphosate-europe

4 https://www.tandfonline.com/doi/pdf/10.1080/21645698.2017.1390637

5 https://doi.org/10.1093/jnci/djx233

6 https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2018.5348

7 https://www.ams.usda.gov/sites/default/files/media/2016PDPAnnualSummary.pdf.pdf

8 https://www.fda.gov/Food/FoodbornelIlness-Contaminants/Pesticides/ucm618247.htm

9 Ames, Profet, Gold 1990: Dietary pesticides (99.99 % all natural), Medical Sciences 87/1990

10 https://nas-sites.org/ge-crops/

11 https://royalsociety.org/~/media/policy/projects/gm-plants/gm-plant-q-and-a.pdf

12 https://www.bestfoodfacts.org/what-foods-are-gmo/

13 http://www.plantmanagementnetwork.org/pub/php/review/2003/papaya/

14 https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0111629

15 https://www.wired.com/story/crisprd-food-coming-soon-to-a-supermarket-near-you/

16 https://www.mpg.de/10444274/genome-editing-breeding-better-crops/

17 https://ourworldindata.org/yields-vs-land-use-how-has-the-world-produced-enough-food-for-a-growing-population

18 https://www.publiceye.ch/en/topics-background/agriculture-and-biodiversity/seeds/

19 https://www.nature.com/articles/nature11069

20 https://www.annualreviews.org/doi/10.1146/annurev-resource-100517-023252

21 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32007R0834

22 https://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=9874504b6f1025eb0e6b67cadf9d3b40&rgn=div6&view=text&node=7:3.1.1.9.32.7&idno=7

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