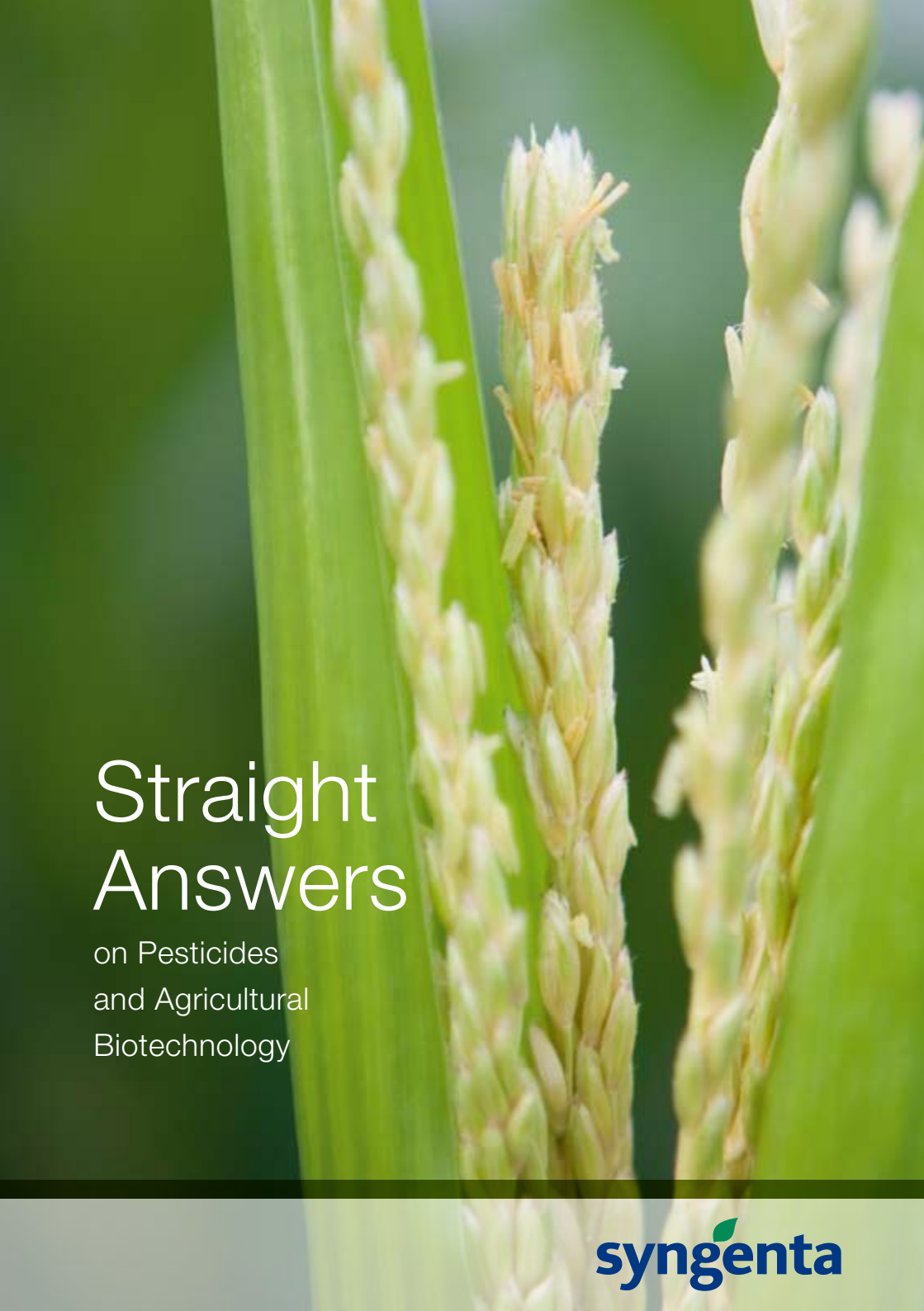

Straight Answers

on Pesticides and Agricultural Biotechnology

syngenta

Contents

Introduction

Farming and Innovation

Modern agriculture is often criticized because it is thought to be too industrialized, scientific and technological; too separated from the natural world and too independent from consumers. Many also believe that organic agriculture is inherently better for the environment and their health.

No farming is completely natural and very little sustainable farming is completely organic. Humans have transformed many landscapes in the several thousand years since our ancient ancestors first started to select and cultivate wild grasses for food. This apparently simple but momentous step enabled our species to move from a precarious hunter-gathering existence towards today's industrialized socio-urban communities in which relatively small numbers of farmers grow food for many millions of people.

As farming has developed, the managed landscapes with which we are familiar have been created, producing a wide range of fauna and flora. Whether in family-owned smallholdings or large mechanized farms, the land now used for agriculture is predominantly shaped by humans and not by nature.

Over the centuries, farming methods have evolved, with major developments such as the introduction of the plow, field enclosure, the use of chemicals to protect crops from damage, the invention of synthetic fertilizers and the development of hybrid plant varieties. More changes prompted by scientific and technical research are imminent.

Syngenta's position at the heart of farming continues this tradition by supplying farmers with a wide range of high quality crop seed varieties and chemical products which protect both the seed and the crop.

Productive farming is about using strong and healthy seed and fulfilling the yield potential of crops by reducing losses due to pests and diseases. With a rapidly-growing global population demanding more and better quality food, the agricultural sector faces even more challenges, compounded by the increasing interest in using crops as a source of fuel and industrial raw materials and the impact of more extreme weather conditions. Innovative technologies and practices will continue to bring solutions to meet the growing demands of current and future generations.

The farmer's continuing role as the true environmentalist, the protector of the land, and the guarantor of sustainability is often not well understood by the general public. Many are not informed about the source of their food, and have sincere concerns about modern farming methods.

This publication provides straight answers to some of the more common questions, prompted by these concerns, that people often ask about modern farming. We hope it will help increase understanding and acceptance of the important role that the technologies and products provided by Syngenta play in making agriculture more productive and sustainable.

Are pesticides really necessary?

Pesticides are not only necessary to protect crops from damage: the world's increasing population simply cannot be fed without them.

The term "pesticides" is often used to describe the various crop protection products (insecticides, herbicides, fungicides) that are used against pests that cause damage to plants, such as insects, weeds, and diseases.

Plants themselves naturally produce a wide range of chemicals to protect themselves against pests, but these are not enough to prevent large losses of food crops. In fact, it is estimated that between 35% and 40% of all crops would be lost to insects, weeds and disease without appropriate pesticide use[1].

Farmers have always struggled to defend their crops and improve their yield. For hundreds of years, a range of chemicals – natural and synthetic – has been used in the battle to protect the food supply from pests, weeds and diseases.

The widespread use of newer and more effective pesticides since the middle of the twentieth century has increased food security and improved standards of living around the world; without them, crop losses would be far higher and we might not be able to grow enough food on the land currently farmed. Pesticides also help to safeguard public health by controlling pests that spread disease to people and livestock or cause damage to homes and property.

By their very character, these products have to be toxic (harmful) to the targets at which they are aimed. As with many other very useful and beneficial substances in daily use (such as bleach or petrol/gasoline), they can cause serious harm and injury to people if misused. However, modern pesticides are specifically designed to have three characteristics: they must be **safe** (except to their intended targets); they must be **specific** to those targets; and they must be **short-lived**, disappearing or breaking down harmlessly after achieving their aim. They are only approved for use after exhaustive testing and regulatory evaluation according to these criteria by independent experts.

A combination of the rapidly increasing global population and greater demand for more varied and nutritious food, particularly in Asia, means that overall food demand is expected to double by 2030. As just one example of what this means, we will need to produce an extra one billion tons of grain annually by that time[2].

This also means there will be greater pressure on the land available for agriculture. The FAO reports that cultivable land in proportion to population has already decreased from a worldwide average of 0.38 hectares per head in 1970 to 0.23 hectares per head in 2000, with a forecast of 0.15 hectares by 2050[3]. At the same time, crops for fuel and feed are competing for this land.

To feed the world, we must learn to grow more food on less land so that we do not encroach on areas preserved for environmental reasons, rain forests or other land currently not cultivated. The only way to do this sustainably is by using modern technologies and products such as pesticides to maximize the harvest. The risks of doing nothing or of arbitrarily limiting pesticide use means less yield from the land. This risks increasing food insecurity and economic stagnation in developing countries and disrupting the global food production and supply chain. Pesticide-free agricultural methods simply cannot address the rapidly increasing global challenges.

"Pesticides are not only necessary to protect crops from damage: the world's increasing population simply cannot be fed without them."

2

Wasn't food a lot healthier before the widespread use of pesticides? Aren't even trace amounts of pesticide harmful?

Food was certainly not healthier before pesticides were used. Infestation with dangerous pests and diseases was common and persistent before the widespread application of pesticides to crops. Pesticides are a key tool for securing safe, varied, affordable and healthy diets.

There are many myths and misconceptions about pesticide residues on fruit and vegetables. In particular, the fact that a substance is harmful at high levels does not mean it is unsafe at lower levels. Beneficial medicines can also be harmful to health if too high a dose is taken, and even too much salt or water can be lethal.

Residue levels are highly regulated and constantly monitored. Maximum legal levels typically incorporate at least a 100-fold safety factor. There is no evidence that the minuscule pesticide residue found on some fruit and vegetables has any effect on people's health: the produce is perfectly safe.

The World Health Organization's global strategy on diet, physical activity and health identifies poor diet and lack of physical activity as two of the main causes of death from non-communicable diseases such as cardiovascular disease, type 2 diabetes and some cancers[4]. Approximately 2.7 million deaths annually are attributed to low consumption of fruit and vegetables[5], but pesticides are never featured as a factor in mortality figures.

Pesticides have enabled farmers to produce a more affordable and abundant supply of fresh food than ever before; and due to this, global consumption of fruit and vegetables has doubled in the past 50 years[6]. The advantages of this trend heavily outweigh any concerns about pesticide residues in food.

In the USA, the National Academy of Sciences concluded that the significant increase in life expectancy of Americans up to the early 1990s was partly attributable to the increased availability of affordable fruit and vegetables, made possible by the use of effective pesticides[7]. The UK Food Standards Agency (FSA) advises on its website that not eating any fruit and vegetables would be a much bigger risk to health than eating foods containing low levels of pesticide residues[8].

Many modern pesticides are synthetic copies of naturally occurring chemicals, modified to be safer to apply or to have a lower environmental impact. These are applied with the objective of killing the pest with the least amount of residue.

In most cases, these synthetic pesticides are no more toxic than their naturally occurring counterparts. US scientist Bruce Ames points out that the daily consumption of natural pesticides or carcinogens outweighs the traces of synthetic pesticides consumed by the public by many thousands to one[9], and illustrates this by observing that the known natural rodent carcinogens in a single cup of coffee are about equal to an entire year's worth of carcinogenic synthetic pesticide residues[10].

“Infestation with dangerous pests and diseases was common and persistent before the widespread application of pesticides to crops.”

Is there any completely safe way to use pesticides?

Syngenta's major commitment to product stewardship seeks to ensure that our products are used as safely as possible to protect human health and the environment.

Protecting the environment and farmers' health is our top priority, and cannot be compromised. Proper use of crop protection chemicals extends beyond careful selection, preparation and application through to the disposal of the pesticide in its various forms.

The Syngenta Product Stewardship approach covers the responsible and ethical management of our products throughout their lifecycle, from initial design to withdrawal from the market and disposal of stocks. Syngenta takes the lead in maximizing the benefits of its products and services to customers while minimizing any possible risk. We run "Safe Use" programs worldwide to train farmers and their communities on the proper use and handling of chemicals. Over the years we have trained millions of farmers (3.2 million in 2007 alone). We develop and distribute appropriate personal protective equipment. We also make sure people know what to do if anything does go wrong. We train medical staff at hospitals and poison control centers in the diagnosis and treatment of possible health problems from any accidental over-exposure to pesticides.

Training programs target the priority issues in each country. Vegetable growers in the Shandong province of China were recently trained. In Morocco, the company ran an application training program to help tomato growers reach international standards. This program included demonstrating sprayer calibration and the importance of uniform spray application, which are both crucial in minimizing the risk of unwanted residues at harvest. Improved application techniques help to avoid spray drift, ensuring that the spray stays on the target crop as much as possible and so to avoid any unintended effects on areas that border it.

Since 2004, a major independent stewardship survey has been monitoring the attitude towards safety amongst users of crop protection products[11]. The survey is the largest of its kind ever undertaken on pesticide users, their level of knowledge, attitudes and practices in the safe use, handling, storage and disposal of crop protection products as well as health incidents occurring during agrochemical use. The vast majority of respondents were well aware of the potential risks of using pesticides and 97% stated they had received some form of safe use message within the last three years. The survey has provided a valuable base for Syngenta to define the focus of stewardship efforts over the coming years. Using the data obtained, the company has updated and improved its training materials.

> "Syngenta takes the lead in maximizing the benefits of its products and services to customers while minimizing any possible risk."

4

Surely food from organic agriculture is inherently better than food produced with pesticides?

Organic food is neither safer nor of higher quality than food grown with pesticides.

Although some may choose to eat only organic food, this is more of a lifestyle choice than one producing additional health benefits. In fact, objective scientific research has shown that organic food does not have the safety or nutritional advantages which many people associate with it. Nutritional benefits are sometimes reported, but an examination of the studies invariably finds partial or unbalanced use of data.

The UK Food Standards Agency has stated: "In our view the current scientific evidence does not show that organic food is any safer or more nutritious than conventionally produced food"[12]. Similar conclusions were drawn by the French Food Safety Agency (AFSSA)[13] and the Swedish National Food Administration[14]. In the USA, the Institute of Food Technologists issued a summary of the scientific status in which it reported that "It is premature to conclude that either food system is superior to the other with respect to safety or nutritional composition" while "marginal benefits of reducing human exposure to pesticides… appear to be insignificant"[15]. A major European study[16] found no significant difference between organic and conventional food, regarding levels of mycotoxins, heavy metals, PCBs (polychlorinated biphenols), radioactive contamination, or even with respect to food components such as vitamins, nutrients, and aromatic compounds.

Contrary to common belief, organic farmers are allowed to use a range of toxic pesticides and other chemicals on their crops[17, 18] (over 20 synthetic chemicals in the USA and eight in the EU, for example), but the philosophy of the movement permits only those considered to be of natural origin or that have been used traditionally. For example, copper-based anti-fungal treatments are permitted, even though in all other areas of life it is normal to avoid significant use of such heavy metals because they are dangerous and persistent in the environment. The risks of the organic pesticides used in organic farming are not as extensively investigated as are synthetic pesticides. They are also not subject to the same stringent safety standards and regulations as chemicals used in conventional farming.

The ten-year Boarded Barns Farm study[19], which was undertaken by Aventis CropScience (now Bayer CropScience) in 1998, compared three farming systems: organic, conventional (including pesticides) and Integrated Crop Management (ICM). To take one of the findings, whilst no difference was found in the nutritional value of bread produced using wheat from the three, organic loaves were scored significantly and consistently lower for visual appearance, taste and texture. This was largely due to the lower protein level in wheat grown this way.

A study by Strathclyde University[20] compared conventional, organic and free-range chicken breasts and found that organic products scored lower in all the nutritional tests carried out. Organic varieties contained lower levels of antioxidants, and also fewer omega-3 fatty acids, which gave the meat an inferior taste.

After reviewing over 200 studies on diet and cancer, Professor Anthony Trewavas (Edinburgh University) stated: "Although it has been claimed that organic produce is healthier food than conventional produce, the current evidence does not support this contention."[21] Professor Christine Williams of Reading University came to a similar conclusion: "There appears to be a wide-spread perception amongst consumers that such organic methods result in foods of higher nutritional quality. The present review concludes that evidence that can support or refute such perception is not available in the scientific literature."[22]

"Organic food is neither safer nor of higher quality than food grown with pesticides."

Isn't organic agriculture much more sustainable than agriculture using new technologies?

The increasing world population requires even higher crop yields from the land available for agriculture. The output from organic agriculture would not be sustainable or sufficient to feed a growing global population. Lower crop yields from organic farming mean that much more land would be needed to grow enough food this way.

With the world's population projected to grow from the present 6.7 billion to 9.2 billion by 2050[23], it is vital to optimize the use of available agricultural land. The FAO (Food and Agriculture Organization of the UN) found that to do so, no less than 80% of the necessary increase in crop production would have to come from intensification (more yield from the same amount of land).

Organic farming currently occupies 31 million hectares (including pastures) which is just 0.6% of total world land use for food production. Available data indicates that organic production yields are between 50 and 80% of those from conventional agriculture. For example, a paper by the Swiss Research Institute for Organic Agriculture reports yield reductions of 40% for potatoes, 30 – 40% for cereals and 20% for the organic trials overall[24]. One estimate for additional land requirement if organic farming was to be widely adopted is that the lower yields would require between 25% and 82% more land to sustain food production. In the same paper, the authors conclude that organic production can be bad for the environment because of lower nitrogen use efficiency[25]. A study by researchers at Manchester Business School highlighted the environmental burden posed by organically farmed tomatoes. According to the report, it takes 1.9 times more energy to produce one tonne of vine-ripened organic tomatoes than it would using conventional methods. The reason is that the relative land-use for organic versus conventional in this example was 146 square yards as opposed to 23 square yards[26].

Other researchers have also cast doubt on the sustainability of organic management systems. For example, a group in New Zealand concluded that "There needs to be a greater research effort to establish whether these nutrients [nitrogen and trace elements] can be supplied in adequate amounts under organic farming without depleting the soil reserves"[27]. A Dutch researcher has concluded that organic coffee cultivation in Latin America is not sustainable: yields fall to below profitable levels, partly because sufficient composted organic matter is unavailable to the farmers[28]. On the other hand, in India, no-till management – made possible by use of herbicides for weed control – increased wheat yields after the first year, while significantly reducing water use[29], so making a positive contribution to sustainability.

Available evidence leads to the inevitable conclusion that, whatever environmental benefits organic farming may be shown to have for some crops or on small areas of land, it is not a sustainable system which can be applied to the majority of food production the world requires.

Syngenta invests heavily in making crop protection products target-specific, non-persistent and able to meet the growing demands of consumers. Crop yields are increased whilst protecting and enhancing biodiversity and the environment. With the higher yields made possible by pesticides, farmers can produce more food on less land. Pesticides also help make sustainable farming practices such as no-till farming possible, help reduce soil erosion and preserve wildlife-rich habitats. With food demand at its highest level ever and continuing to rise, farmers – experts in sustainable agriculture and guardians of the environment – must be enabled to grow increasing amounts of crops from land already in production.

"The output from organic agriculture would not be sustainable or sufficient to feed a growing global population."

6

Surely no-one knows how toxic mixed combinations of pesticides can be?

The active ingredients and the formulations of commercial pesticides have been extensively risk-assessed and safe residual levels have been defined. There is no evidence to suggest that pesticide mixtures pose any significant risk above what is already known about the individual components.

The presence of multiple pesticide residues in food has been increasingly under question from environmental groups. Some argue that not enough is known about the health risks of such mixtures. In practice, however, both the ingredients and formulations of pesticides are subjected to thorough toxicology studies and risk assessment before approval by the regulatory authorities in the countries where they are marketed. Potential risks from manufacture, distribution, spray application, product disposal and consumer exposure to treated food are assessed in great detail by independent scientists before pesticides are approved.

Assessing the combined risk of substances with similar toxicological effect is relatively simple. The effects of the substances are additive and the risk can be assessed cumulatively. It is more difficult to assess the safety of multiple pesticide residues when they have different toxicological effects. In these cases, the toxicity of the mixture depends on that of the individual components in the relevant proportions, and any synergies between them.

On a daily basis, humans ingest vastly greater quantities of an enormous range of naturally occurring plant chemicals without harm. Much more is known more about the properties of synthetic chemicals than about naturally occurring chemicals.

In addition, regulatory authorities in several countries such as the USA and UK have developed guidelines for the cumulative risk assessment of chemical mixtures[30]. The German Institute for Risk Assessment (BfR) cited two scientific prerequisites for the development of a comprehensive concept for assessing the safety of multiple residues: more exhaustive data on exposure and more investigations on the effects of and possible interactions between multiple substances[31].

Syngenta believes that any cases of unpredicted toxicity from mixtures with synergistic action would be unlikely to pose a significant health risk. This is due to the large margin of safety (at least 100-fold) already existing for the individual chemicals whose Maximum Residue Levels (MRLs) are defined by regulatory authorities.

> “There is no evidence to suggest that pesticide mixtures pose any significant risk above what is already known about the individual components.”

Do pesticides contaminate drinking water and generally poison the environment?

Appropriate labeling, recommended usage, and clear instructions on use all play a decisive role in ensuring that the environment is not damaged when our products are used as intended. Syngenta is conscious of our wider responsibility to protect the environment and water sources and to ensure that our products, when used correctly, do not adversely affect the environment.

Fresh water is becoming a scarce resource in some regions, and agriculture is the major user of water. To help protect the quality of this resource, Syngenta conducts a thorough risk assessment on the possible impact of its products on water and on the wider environment. Our products are only marketed after passing rigorous assessments for regulatory compliance (for each individual country), technical effectiveness, and lack of unacceptable side effects. In Europe, a very strict pesticide threshold of 0.1 µg/l in groundwater or drinking water is applied. This value is equivalent to a drop in an Olympic-size swimming pool and is, given the dilution, effectively a substitute for zero.

Many pesticides are synthetic copies of naturally occurring chemicals, modified to be more effective against pests or kinder to the environment. In most cases, the synthetic pesticides are no more toxic than their naturally occurring counterparts and cannot therefore be shown to be harmful to the environment. When used wrongly, pesticides can pose an environmental threat and this is why we encourage their safe use through targeted projects. We provide funding and expertise for over 30 programs worldwide supporting soil conservation and water quality as well as training on how to apply and store pesticides safely.

The application of Good Agricultural Practice (GAP), as supported by the FAO[32], helps to minimize levels of crop protection products in ground and surface waters. GAP methods include the use of best available techniques to ensure the most accurate application of products, reduced spray drift, better container management and safer storage. Integrated Crop Management (ICM) enables farmers to identify precisely when and where pests, weeds and diseases are present and to control them using the lowest possible rate of the most effective crop protection product. All this helps to eliminate the movement of excess pesticides into water.

Syngenta collaborates in the TOPPS Project (Train the Operators to Prevent Pollution from Point Sources)[33], a pan-European project funded by the European Commission. This aims to disseminate advice, information and training within Europe to raise awareness and minimize the amount of crop protection products which reach water systems due to careless handling of containers. Our Safe Use training programs in, for example, Latin America and China cover correct handling and disposal to ensure that water or land is not unintentionally contaminated.

“We provide funding and expertise for over 30 programs worldwide supporting soil conservation and water quality as well as training on how to apply and store pesticides safely.”

Do pesticides damage biodiversity, in particular soil quality and structure?

Correctly applied, pesticides allow soil structures to be maintained and reduce the need for plowing. Similarly, pesticide use improves crop yields and allows land to be used more effectively, benefiting biodiversity in the field and surrounding areas.

At Syngenta, our products help to make the most of existing farmland, thereby supporting biodiversity. The company is committed to the optimization of natural resource management, to the maintenance and enhancement of the economic viability of farming, and to the protection of biodiversity and the environment more generally. Our biodiversity projects worldwide are designed to identify and promote best practice[34].

A key challenge is to reconcile biodiversity conservation with global population increase, the necessary increase in food production, and economic growth. We subscribe to the objective of the Convention on Biological Diversity – to halt the loss of biodiversity and secure its beneficial uses and fair and equitable sharing. Syngenta also complies fully with the guidelines established by the 2000 Biosafety Protocol, to minimize the potential risks to biodiversity posed by living modified organisms (see the section on crop biotechnology for more information)[35].

Research has shown virtually no evidence of any long-term harmful effects of using a typical range of agricultural pesticides on the soil microbial biomass or its activity[36]. Whilst it is difficult to assess the likely impact of field use pesticides on below-ground ecology[37], nutrient pools in organically farmed soils are essentially the same as in conventionally managed soils[38].

In physical terms, soil is damaged by repeated tilling or plowing. Appropriate use of herbicides facilitates no-till or conservation-tillage farming. With this technique, seeds are sown directly into the previous crop's stubble. No intermediate tillage takes place, and the upper soil layer is preserved. Wind and water erosion, as well as loss of ground moisture, can be greatly reduced as compared to mechanical weed control through ploughing. Other benefits include improved levels of soil organic matter, enhanced soil aeration, preservation of soil structure and soil fauna as well as reduced fuel/labor requirements. Conservation tillage is enabled by herbicides and has reduced erosion by up to 95%. A farmer in Pennsylvania, USA reports that he has used this combination on his sloping fields for more than 15 years. He finds that organic matter in his soil is up from 2.7 to 4.3%, with some fields reaching 6%[39]. This increase of over 50% in organic matter is not atypical. It contributes to a continuous improvement in soil fertility. Syngenta actively supports such approaches, and was a partner in the European Commission project SOWAP (Soil and Water Protection), which published a summary of Conservation Agriculture in Europe in 2006[40].

Many of the perceived biodiversity benefits from organic methods have little to do with the crops themselves and much more to do with other environmental factors around the farm. A recent study, for example, found that "a significant proportion of the enhanced bird abundance on organic farms may be attributed primarily to an increase in the quality and quantity of non-cropped habitats and boundaries."[41] Crops themselves are a major determinant of biodiversity, with fields of oilseed rape attracting many more pollinating insects than the same area of maize.

Farmers need a broad range of technological solutions, including safe pesticides to sustain their business, to help produce enough food to feed the world, and to compete globally. By embracing technological innovation, agriculture can deliver a range of environmental and economic benefits, including reduced soil erosion and biodiversity protection. Modern farming, environmental protection and respect for biodiversity are inextricably linked.

"Modern farming, environmental protection and respect for biodiversity are inextricably linked."

Do pesticides increase childhood allergies?

Rather than causing allergies, pesticides have a beneficial impact by reducing and controlling pest insects that cause allergies and carry diseases.

Numerous scientific studies have documented the correlations between, for example, cockroach populations and childhood asthma, insects and disease, and rodents and health epidemics. Insects such as cockroaches and houseflies carry and spread various organisms that cause diarrheal diseases, rated by UNICEF as the primary killer of children under age five. Allergens, viruses and bacteria can be present in levels high enough to cause disease, even after extermination and rigorous cleaning, if pests are allowed to establish themselves in the first place. But in areas treated with pesticides, cockroach allergen levels drop sharply, by between 77% and 91%[42]. This can be taken as an indication of the general level of disease reduction possible via pest control.

When serious vectors (transmitters of disease) and nuisance insects are controlled, previously uninhabitable areas become habitable and quality of life increases in both rural and urban environments. When used according to recommendations, pesticides can have a positive effect on children's health. In addition to their benefits for agriculture, pesticides help protect children and families from insect pests like cockroaches, fire ants, bees, wasps, mosquitoes, poison oak and ivy, rats, and mice."[43]

In developing countries, the benefits of pesticides in regard to children's health are even more pronounced. In public health, insecticides are used to control the insects that spread serious diseases such as malaria that result in an estimated 5,000 deaths each day[44]. A mathematical model[45] of the spread of the tropical disease leishmaniasis found that insecticidal control of sand flies represents a more effective way of reducing transmission to infants than the present strategy of culling infected dogs.

“Rather than causing allergies, pesticides have a beneficial impact by reducing and controlling pest insects that cause allergies and carry diseases.”

What is being done to stop pesticides from being used for suicide?

Syngenta's pesticides are safe and effective when used for their intended purpose. Syngenta supports highly successful projects with internationally renowned experts and non-governmental organizations in the field of suicide prevention.

For a number of reasons, it is a tragic reality that suicide with agrochemicals is a public health issue in some developing countries. In order to address this, Syngenta has formed partnerships with a number of government agencies, the WHO (World Health Organization), associations of mental health professionals and community-based suicide prevention and women's groups. Syngenta also supports the WHO's secure storage initiative for pesticides and respective guidance to countries[46].

According to the WHO, the use of pesticides for suicide is the biggest public health problem concerning crop protection products. Syngenta is committed to making all efforts to minimize the possibility of misuse consistent with our customers' need for access to the products. Consequently, the company has taken a leading role in publicly identifying this issue and organizing a broad-based coalition of governments, academics, the WHO and NGOs to address it[47].

The association of pesticides with suicide has arisen because, in rural areas, someone with suicidal inclinations may find agricultural chemicals as the first means at hand. Secure storage is an effective solution that benefits our customers and their families, as evidenced by the positive results of the many projects Syngenta runs to promote this. In Western Samoa, the company brought together a coalition that has successfully decreased suicides to levels not known since the 1960s[48]. In two rural provinces in Nicaragua, Syngenta's work with the government resulted in a drastic decrease in suicides[49]. Similarly, multi-stakeholder approaches in Sri Lanka are starting to show positive results and other programs are being started in a number of other Asian countries[50, 51].

Overall, controlling access to agricultural chemicals seems to have a big effect on the rate of suicide where the act is the result of a short-term problem or feeling of despair. Unfortunately, nothing will prevent the suicide of someone determined to take their own life by whatever means they can find.

Syngenta's commitment and role in reducing rural suicides were recognized by Prof. Mort Silverman of the University of Chicago who spoke at the 2006 International Association for Suicide Prevention Symposium in Singapore: "I applaud Syngenta for their efforts to date and for reaching out to our communities for our welfare. Today, I have come to appreciate Syngenta's sincere commitment to a global stewardship that speaks volumes about its commitment to people, communities and the environment."[52]

> "Syngenta's pesticides are safe and effective when used for their intended purpose."

Why should a pesticide be allowed in one country when it is banned in another?

Crop protection and pest control methods are different from country to country as a result of the diverse crops grown, climatic conditions and particular species of pests and diseases present.

Regulatory guidelines and decisions about which pesticides can be used are primarily made at the country level. While a particular pesticide may be essential in countries with warm climates, it may not be very valuable and beneficial for crops grown in cooler climates, where there are different ranges of pest problems and agricultural practices.

An example would be cereal crops in Europe. In the north and west, fungal diseases are major problems, and hence fungicides are widely used. In southern areas, the hotter, drier weather makes fungicides generally unnecessary, but crops instead have to be protected against a larger range of insect pests.

Equally, different crops are farmed in different climatic regions. Tomatoes, peppers, grapes and peaches are generally grown in Mediterranean countries and must be protected against a range of insect pests which cause direct damage and spread disease. Further north, crops such as cabbage, carrots, barley and potatoes predominate and are susceptible to completely different pests and diseases.

Regulatory authorities will only approve particular pesticides if there is a need for them. So, the fact that an active ingredient is allowed in one country but not in another is no reflection of the relative safety of the compound or the stringency of the safety assessment. There are also cases where the same pesticide may be approved in two countries for different uses, since this reflects the type of crops grown in each.

For agriculture to be truly sustainable, an adequate and appropriate range of pest control techniques should be available to farmers. This range will inevitably vary from country to country. However, it is often misleading to say that a substance is "banned" in a particular place simply because it is not registered; generally, it has never been approved for use because there is no need for it or because re-registration may not be needed due to other product solutions.

Syngenta's policy is to ensure the responsible management of all its activities from product invention to use and discontinuation, and to meet or exceed regulations, legal requirements and international agreements. For example, Syngenta has supported the principles of the Rotterdam Convention on Prior Informed Consent (PIC)[53] since their adoption in 1989 as a voluntary procedure under the FAO Code of Conduct. The treaty aims to help participating countries make informed decisions about the potentially hazardous chemicals that might be shipped to them, and to facilitate communication of these decisions to other countries.

PIC provides additional safeguards to protect human health and the environment, especially in those countries where effective regulatory controls are rudimentary. However, the principles are no substitute for robust and effective national regulation, and we continue to work to build capacity to achieve this in all countries.

"For agriculture to be truly sustainable, an adequate and appropriate range of pest control techniques should be available to farmers."

Do we really need biotech crops?

We need all available agricultural technologies, including biotechnology, to meet the current and projected global demand for food, feed, fiber and biofuels. Biotechnology can improve productivity, secure yields, and improve quality of crops, while minimizing the environmental impact of their production.

The projected increase in world population over the next decades will put huge pressure on farmers to produce more than twice as much food – sustainably – from the same area of farmland and with limited supplies of fresh water[54, 55].There will be about 2.5 billion more people needing food by mid-century, and demand for meat will rise more steeply as the developing world becomes more prosperous. The supply of biofuels and renewable raw materials for industry will put further demands on agricultural productivity. Now, more than ever, yield-protecting and enhancing technologies are needed.

Even with effective modern pesticides, over a third of the world's harvest is still lost to pests, weeds and diseases, and conventional plant breeding is not increasing yields fast enough to keep up with growing demand[56]. Plant biotechnology adds another powerful tool to help boost productivity. In many countries, it has been taken up enthusiastically, and at a global level has proved to be the most rapidly adopted new farming technology ever. In 2007, 12 million farmers in 23 countries around the world grew biotech crops on over 114 million hectares of land[57].

Biotechnology can be used to improve plants in ways not yet possible with conventional breeding techniques. The current generation of crops has been developed to deliver consistently high yields by protecting them against insect attacks or making them resistant to herbicides so that weeds can be controlled more effectively. Biotechnology has helped increase U.S. crop yields in the past few years, and for corn alone, yields have increased by 30% on average since the commercialization of biotech corn in 1996. Romanian farmers have enjoyed a doubling of soybean yields since introducing biotech varieties. Biotech corn varieties have contributed to crop yields in South Africa and Argentina by 10% respectively. Farmers in China reported a 24% increase in cotton yields over 3 years, while farmers in the Philippines have reported an increase in maize yields up to 60%[58].

Biotechnology has a wide range of applications and is now also being used to improve tropical subsistence crops such as cassava. Other crops are being developed to resist drought and salty conditions – a very important step for helping farmers deal with the effects of climate change. For consumers, biotech crops can produce healthier cooking oils, as well as fruits and vegetables fortified with vitamins.

Today, after over a decade of use, crops developed through biotechnology have delivered significant benefits and have a proven record of safe use. Concerns have focused on the theoretical risks of the technology itself, without considering the very real benefits for farmers and consumers. Each biotech crop is evaluated individually before approval, and experience of safe use and consumption gives confidence in this valuable and productive tool for sustainable agriculture.

“Biotechnology can improve productivity, secure yields, and improve quality of crops, while minimizing the environmental impact of their production.”

Are biotech crops safe for humans? Will they cause allergies?

All biotech crops are rigorously assessed for allergenic or toxic properties for humans or animals before regulatory approval. Biotechnology is in fact being used to develop foods with reduced potential to cause allergies.

Leading scientific bodies, regulatory agencies and international organizations have concluded that approved biotech products are as safe as or safer than similar crops developed using more conventional breeding methods. Agricultural biotech products are the most stringently tested food products available on the market, and far more is known about them than any other foods we eat.

Typically, breeding involves the crossing of tens of thousands of uncharacterized genes. Genetic modification allows us to make precise changes to a handful of genes at most, and the new varieties are subject to the highest standards of evaluation for safety.

Many of the reports alluding to the dangers of biotech crops have been shown to be flawed or unreliable. Most importantly, no-one has ever been able to reproduce the apparently negative results of the few studies claiming that biotech crops are unsafe. Meanwhile, over the past ten years, billions of people around the world have safely consumed biotech foods on a daily basis.

Food allergies are a concern for many people. Approximately 90% of food-related allergies are caused by proteins found in a range of common foods: tree nuts, peanuts, soybeans, milk, eggs, fish, crustaceans, and wheat[59]. Breeding companies avoid introducing genetic material from these foods in developing biotech products.

In addition, biotech crops are always screened for potential allergens as part of the approval process. Development of two types of biotech crops (one by the private sector and the other by a publicly-funded research group) was stopped at a relatively early stage because tests picked up potential allergenicity problems. One case was of soy modified by scientists with a gene from the Brazil nut (to which a significant number of people are allergic)[60]. In the other case, pest resistant peas developed by a research group at Australia's Commonwealth Scientific and Industrial Research Organisation expressed a protein which gave allergic reactions in mice[61]. That these projects did not move forward indicates that the system is working and that good testing according to scientific protocols ensures safety.

The state of knowledge of plant genomes now allows biotechnology to be used to modify or remove existing allergens from certain foods. Hypoallergenic rice and soybeans have already been developed, and researchers are at work on wheat and peanuts[62]. Continued research and product development in this area will expand the choice of foods available to those who suffer from food-related allergies.

“All biotech crops are rigorously assessed for allergenic or toxic properties for humans or animals before regulatory approval.”

Don’t biotech crops harm bees, butterflies and other useful insects?

Biotechnology delivers biodiversity benefits in numerous ways with minimal impacts on non-target organisms.

Any type of farming disrupts existing eco-systems, but also provides habitats for a range of adapted insect, bird and mammal species on the field and in surrounding areas. Farmers aim to protect their crops from damaging species which can significantly reduce yields. Insect-resistant biotech crops produce proteins derived from the soil micro-organism Bacillus thuringiensis (Bt), which is also used by organic farmers as an insecticide. This avoids the need to spray against insect pests, and affects only those which feed on the crop.

In May 1999, “Nature” published an article from researchers at Cornell University that reported findings from laboratory experiments suggesting further research was needed into the effects of pollen from selected strains of Bt corn on the Monarch caterpillar[63].

Since that publication, many university researchers, including others at Cornell, have concluded that the Monarch study did not represent natural conditions. In practice, the planting of large areas of biotech corn in the American Mid-West has had no effect on the population of Monarch butterflies, which has continued to fluctuate according to variations in other factors[64]. Concerns have also been raised about the effect of Bt proteins on bees. Work by Swiss scientists concluded that there was no evidence of any harm[65].

In fact, rigorous scientific studies show that Bt proteins are specific in their pest control activity, and thus have low environmental impact in general[66]. Bt proteins also degrade rapidly and therefore do not persist in the environment.

Recent reviews and many publications describing research on non-target organisms conducted in the field and laboratory provide a weight of evidence confirming the safety of biotech crops to non-target species.

A meta-analysis of 42 field experiments with Bt crops showed that there was no effect on the abundance of non-target organisms and that Bt crops can reduce the environmental impact of agriculture[67]. Studies have shown that songbirds have actually returned to agricultural fields in increasing numbers as biotech crop acreage has expanded[68]. This is true not just for industrialized countries, but also Africa and other developing regions; improved yields and reduced need for conventional crop protection can help small-scale farmers promote biodiversity[69].

Far from harming the environment, plant biotechnology can improve soil health, as well as assist in the conservation of topsoil and moisture content, which plays a significant role in encouraging the growth of habitats that support different varieties of wildlife.

“Biotechnology delivers biodiversity benefits in numerous ways with minimal impacts on non-target organisms.”

15

Won't biotech crops escape into the wild, harm biodiversity and create "superweeds"?

Biotech crops are helping to protect and enhance biodiversity. There is no credible evidence that those biotech crops currently approved are, or could become, more difficult to manage than conventionally bred crops.

Crop plants bear little resemblance to their wild ancestors, having been selected and bred over many centuries to secure food yields. Possessing beneficial agronomic traits does not make a crop more fit to survive in the wild – in fact, such crops are unable to compete with wild plants and will not survive for long without continued cultivation. Any crops – however they have been bred – can cross-pollinate with related species on neighboring ground and so transfer their genes into weed species. However, because of the qualities that crop varieties have been selected for, this gives the new hybrids no competitive advantage.

Biotech crops are no different. A British study found that herbicide-tolerant crops did not survive well in the wild and were no more likely to invade other habitats than other unimproved crop plants. The seedlings did not become self-seeding, self-sustaining plants, and they did not spread into surrounding areas[70].

Most crops do not have wild relatives growing nearby. Maize in Europe, the United States or Africa, or soy in South America, for example, are introduced species and cannot cross-pollinate with native weeds. Nevertheless, some opponents of biotechnology have falsely promoted the concept of "superweeds" claiming that wild crops would acquire biotech traits, spread, and be very difficult to control.

However, even in cases where gene flow can take place (between herbicide tolerant canola and wild brassicas, for example), the resulting weeds (resistant to the herbicide used with the biotech crop) remain controllable with many other herbicides. They would, in any case, have no competitive advantage in the wild and would only need to be controlled in farmers' fields. Herbicide tolerance in weeds can develop over time and farmers have a long history of managing it successfully.

Similarly, there have been concerns about transfer of protection against insects to wild plants and rapid development of a pest population resistant to Bt.

Biotechnology companies and farmers use "resistance management plans" to delay the inevitable emergence of resistance and to impede the spread of any resistance that does emerge. These plans entail a variety of agronomic practices and tools. With Bt crops, for example, a key element of resistance management is creating a 'refuge' – an area or strip of land planted with non-Bt crop varieties that reduces the environmental pressures encouraging insects to develop resistance to Bt.

Biotech crops can make an important contribution to conservation and sustainable use of biodiversity. By reducing the number of sprayings and the amount of land that needs to be tilled, they enable more efficient use of water in agriculture, reduce soil erosion, protect beneficial micro-organisms, improve air quality and reduce the carbon footprint of agriculture. By making farming more efficient on limited land area, they help to prevent habitat destruction – the biggest single threat to biodiversity. The BRIGHT experiment into the impact of herbicide-tolerant biotech crops confirmed that herbicide-tolerant crops help to protect biodiversity[71].

"Biotech crops can make an important contribution to conservation and sustainable use of biodiversity."

Don’t biotech crops actually increase pesticide use?

In many (but not all) cases the amount of spraying is reduced when biotech crops are used. Globally, it is estimated that pesticide applications on certain crops and in certain conditions have decreased 6% in the interval 1996–2004[72].

Farmers need to use the best technologies and management techniques to control pests and produce consistent yields. Biotech crops with built-in pest resistance provide one more tool for the farmer’s toolbox. More tools increase the effectiveness of Integrated Pest Management (the use of a wide variety of chemical, biological and cultivation techniques to control pests), thus further contributing to the sustainability of agriculture.

Biotech crops can play a significant role in reducing the environmental impact of farming. For example, herbicide-tolerant crops facilitate the use of no-till agriculture, which reduces both soil erosion and energy inputs. At the same time, soil organic matter is maximized, which can reduce agriculture’s global emissions of greenhouse gases[73]. Reduced tilling needs very efficient control of weeds, and the most common herbicide-tolerant crops allow the use of glyphosate, which is both highly effective and environmentally benign. Also, by enabling more food to be grown on a limited land area, biotech crops help to reduce habitat destruction and maintain biodiversity.

The use of insect-resistant biotech cotton has led to a large reduction in the use of pesticides[74]. This is a notoriously difficult crop to manage, requiring multiple sprays each season to control insect pests inside the cotton bolls. Bt cotton for example produces its own natural insecticide, so considerably reducing the need for spraying.

“Farmers need to use the best technologies and management techniques to control pests and produce consistent yields.”

In Europe, biotech crops are mostly banned – isn't this an indication that something is wrong with them?

Some biotechnology crops have been approved for cultivation in the EU but an unwieldy, slow and unscientific regulatory system has made approvals of new products unnecessarily difficult. At a global level, biotechnology is the most rapidly accepted technology by farmers ever – and plantings are increasing each year.

Applications for a biotech crop approval in the EU are rigorously assessed by independent scientists on behalf of the European Food Safety Authority (EFSA), and in the great majority of cases approval is recommended. However, many member states then vote against approval, regardless of the evidence and scientific recommendations. Scientists on both sides of the Atlantic regularly agree on the safety of a crop, but many governments in Europe maintain their political opposition to approving the crop for import or cultivation.

A number of biotech crops have been authorized for both food and animal feed use, although very few have been approved for cultivation in the EU, and millions of tons of biotech soy and corn are imported annually as animal feed. In addition, European food manufacturers have been using biotech processing aids such as enzymes for many years. For example, the majority of hard cheese in Europe is produced using transgenic chymosin, the milk-clotting enzyme which also occurs in rennet. Only one biotech crop type – insect-resistant maize made by Monsanto – is approved for cultivation in Europe[75]. Several others have been awaiting cultivation approval for many years and European farmers have expressed their desire to have more choice of new products to use in order to stay competitive[76].

Globally, in 2007, more than 110 million hectares were sown with biotech crops by over 12 million farmers in 23 countries. Seven of those countries were in Europe. France – often presented as strongly opposed to agricultural biotechnology – experienced a tenfold increase in biotech plantings from 2005 to 2006, although more recent government restrictions now prevent farmers from further cultivation[77].

The European public is often perceived to be "anti-biotech", but there is little evidence to suggest that there are serious concerns among the majority of the population. A recent consumer survey by the UK Food Standards Agency, for example, found biotech foods very low on the list of respondents' concerns[78].

In the face of increasing grain shortages and rising prices in Europe, many groups are looking to biotechnology as part of the solution. In addition, the WTO recently ruled that the EU must end its de facto moratorium on biotech products and move forward with approvals[79]. Unfortunately, even in this context, some European countries, under pressure from activist communities and without scientific evidence to support their decisions, have implemented additional bans or restrictions on biotech crop cultivation.

Syngenta believes that farmers should be able to choose the best available technologies to meet their crop production needs in a sustainable way. This needs a predictable political and regulatory environment which is trusted by the public. Science-based regulations ensure that everyone wins – consumers, the environment, farmers and industry.

"Biotechnology is the most rapidly accepted technology by farmers ever – and plantings are increasing each year."

How can we be sure biotech crops won't compromise other types of food production?

Low-level mixing of agricultural crops is inevitable, and not unique to biotech varieties. Allowances for the low-level, accidental (adventitious) presence of biotech material in crop supplies have been recognized in many laws, regulations and standards. This in no way compromises the safety or quality of farm produce.

Seeds and agricultural commodities are typically sold with a small percentage of acceptable contamination by other varieties or even other extraneous material. Even when produced with the most rigorous quality standards, such products may not be 100% pure. This is the case for a variety of reasons – for example, cross pollination, volunteerism (seed from the previous year's harvest germinating in the current crop), mixing during harvesting, transport, storage and processing, human error, and accidents can all play a role[80].

These factors are a reality of agricultural production, and therefore the unintentional, incidental and technically unavoidable commingling of trace amounts of one type of seed, grain or food product with another (also called adventitious presence) is inevitable. However, a complication arises in the case of organic production, where there has been pressure to reject any detectable trace of biotech. This is not a safety issue, but an economic one, as organic suppliers strive to differentiate themselves in the market. Many countries have established thresholds for adventitious presence. Below these threshold levels, trace amounts of foreign material, including biotech material, is allowed. The EU currently does not have a common standard for adventitious presence of biotech seed in non-biotech seed. The lack of clear, harmonized international standards disrupts trade in seed, agricultural commodities and food now that biotech grain and seed is so widespread.

Good agricultural practices easily enable the coexistence of various agricultural production systems in a particular country or region. Such practices are well established and do not burden the different sectors with complex compliance procedures. Indeed, farmers have practiced coexistence for generations in order to meet demands for different types of products. Farm level practices, such as separation of crops by space and time, communicating with neighbours, use of good husbandry, planting, harvest and storage practices, enable successful co-existence and have been practiced by many farmers (seed producers and growers of specialist crops) for many years. To achieve an easily workable regime, it is necessary to set realistic thresholds for biotech presence in alternative systems (and vice versa)[81].

Coexistence between different types of agriculture including biotech and organic production has been successfully achieved without any problems in countries as diverse as Spain, the United States, South Africa, Brazil and Argentina[82]. There is no reason why the continued expansion of agricultural biotechnology should in any way compromise the livelihoods of other farmers as long as they all continue to follow well-established coexistence procedures.

“Good agricultural practices easily enable the coexistence of various agricultural production systems in a particular country or region.”

When will we actually see the "consumer benefits" of biotechnology that have been promised?

Consumers are already benefiting from crop biotechnology; future developments offer even more potential benefits.

The very first biotech products on the market did deliver direct consumer benefits. One was the Flavr Savr® tomato in the USA, which could be harvested fully ripe and be transported without damage. The other was tomato purée in the UK, made from similarly ripe fruit that needed less processing and therefore was sold at a lower price. New biotech crops in various parts of company pipelines offer consumer benefits such as enhanced nutrition, better taste, or reduced potential to cause allergies. Nutritional benefits include fortification of fruits and vegetables with higher levels of vitamins and antioxidants – with the potential to increase protection against the risk of chronic diseases such as cancer and heart disease.

Golden Rice – developed by Swiss scientists with the cooperation of Syngenta – contains higher amounts of beta-carotene (converted to Vitamin A by the body) and iron than regular varieties, which contain no Vitamin A at all[83]. This has the potential to benefit up to 250 million children in developing countries who suffer from blindness caused by Vitamin A deficiency, and an estimated 1.4 billion women who suffer from anaemia[84]. The Golden Rice traits have been bred into locally adapted varieties by the International Research Institute in the Philippines and the biotech event is currently going through the regulatory review process in several countries. For the benefit of the developing world, the Gates Foundation is supporting the nutritional improvement of subsistence crops. The Biocassava Plus project aims to boost the protein, mineral and vitamin content while reducing the content of toxic cyanogens, improving the storage properties and making the plants virus-resistant[85].

Plant scientists have also reduced the proportion of saturated fatty acids in certain vegetable oils using biotechnology, which can contribute to better cardio-vascular health. Other research is looking at ways to deliver needed nutrients in foods such as nuts, milk and pulse crops[86, 87]. Most of these developments are several years away from the market because there is a need for regulatory capacity building and greater public support. In the meantime, agronomic traits have been broadly introduced. Nearly all the biotech seed sold to date has been soy, maize, canola and cotton, modified to be either herbicide-tolerant or pest-resistant. These crops are also benefiting consumers. They improve the quality of food and feed by decreasing the amount of dangerous foreign material (e.g, weed residues) in harvests, and reducing the amount of insect damage to harvested crops. They deliver consistently higher yields, helping to meet increasing food and feed demands.

With the advent of any new technology, there is a tendency for enthusiastic supporters to underestimate the time it takes for products to get to market. By any standards, the commercialization of biotech crops has been a remarkable success. However, exciting lab-scale developments that have sometimes been reported as imminently available are still being researched and reviewed for market entry. It takes many years to move a product through the research pipeline and stringent regulatory systems, and gain public acceptance.

> "By any standards, the commercialization of biotech crops has been a remarkable success."

20

By turning living plants into "intellectual property," isn't biotechnology preventing farmers from the age-old practice of saving seeds?

Nothing Syngenta is doing will take away existing choices from farmers anywhere in the world. Biotech traits are often patented in order to continue an active innovation program. All new plant varieties are in any case protected by Plant Breeders' Rights.

Many farmers in developing countries save seed from year to year, sometimes from locally-adapted land races and sometimes grown from previously-purchased seed. In industrialized countries, a proportion of farmers save seed to plant the following year, but normally also buy new seed every few years to improve their harvest. Some crops – maize in particular – are dominated by hybrid varieties, which are bought each year at a premium because of their high yield characteristics. It is true that some developing world farmers save seeds from hybrid crops, but it is not true that this is their preference. Farmers know that seeds saved from most hybrid plants are not reliable and suffer from substantially reduced yield and highly variable quality. The practice of saving seed is an outcome of the economic situation and the particular economic circumstance of the farmer.

The "farmer's privilege" of saving seed is embedded in international legal systems, such as the UPOV (International Union for the Protection of New Varieties of Plants)[88]. UPOV provides that acts done privately and for non-commercial purposes are outside the scope of the protection of the breeder's rights (which normally last for 25 years). So farm saved seeds produced by subsistence farmers are always excluded from the scope of IP protection. Saving seeds in these respects is permissible and free.

New patented biotech seeds are more valuable to farmers because they offer unique agronomic or quality traits. In short, they help the farmer produce more. All farmers (including non-subsistence farmers) are allowed to save seeds from protected varieties grown on their own farm, for use on their own farm, subject to the safeguarding of the legitimate interests of the breeder, including fair royalties when appropriate. Syngenta fully supports this regime.

Because of the high costs of R&D and regulatory compliance, there are relatively few companies involved in commercial plant biotechnology. Syngenta, in common with other companies in the agricultural sector, has considerable research investments which could not be sustained without strong IP protection. Intellectual property rights systems have been developed and adopted by many countries around the world to encourage innovation, ensure that research-based companies can conduct their business sustainably, to set high standards and to ensure transparency.

Patent applications are published so that the extent of potential protection is obvious and transparent to all. Without such protection, the necessary research investment could not be justified because competitors could freely copy inventions. Patenting also places an obligation on the intellectual property owner to license the technology under fair conditions.

"The "farmer's privilege" of saving seed is embedded in international legal systems, such as the UPOV."

Can biotech crops feed the world?

Biotech crop cultivation is increasing in developing countries, but this should not be regarded as a "magic bullet" that will eliminate poverty and hunger. Food production must be increased substantially, using all possible means.

Factors such as poverty, political instability and poor infrastructure underlie much of the persistent under-nutrition in the world. Food production has to increase to feed the larger population, but there are no "quick-fix" technical solutions to social and political problems.

New agricultural technologies such as genetic modification in conjunction with crop protection can help to protect, secure and increase the food supply around the world. Agricultural biotechnology can be used to increase yields to provide more food by protecting against pests and other environmental challenges such as drought.

In developing countries, where food security is a much more pressing concern than in the industrialized world, biotech crops can help subsistence farmers provide more and better foods for their families or, in the case of revenue crops such as cotton, extract more value from their land. In 2005, the World Health Organization's Food Safety Department found that "the application of modern biotechnology in food and agriculture has the potential to reduce some problems associated with food insecurity"[89].

Biotechnology is also being used to breed crops which are more nutritious, to help minimize the effects of malnutrition. For example, cassava, the fall-back crop for many people in sub-Saharan Africa, is very poor in nutrients, but a project is now under way to develop a variety rich in vitamins and minerals[90]. According to the UN Food and Agriculture Organization (FAO), about 820 million people are malnourished worldwide[91].

This situation is expected to worsen by 2050, when the world's population is expected to reach 9 billion and cultivable land per head is projected to decrease by 50%[92].

The FAO stated in 2004 that "biotechnology can contribute to meeting the challenges" faced by poor farmers and developing countries; "biotechnology can speed up conventional breeding programmes and may offer solutions where conventional methods fail."[93] However, many people in the development sector are ideologically opposed both to crop biotechnology and private sector involvement. Some have a vision of the developing world feeding itself by relying on traditional subsistence agriculture.

But this alone will never lift people out of poverty. Experience in countries which have developed rapidly is that making farming more productive provides additional income, which in turn permits children to be educated and have far better prospects in life. Biotechnology is a tool which, used properly, could substantially improve the food security of poor people and begin to provide them with a path out of poverty.

> "Biotech crop cultivation should not be regarded as a "magic bullet" that will eliminate poverty and hunger."

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