МИНИСТЕРСТВО СЕЛЬСКОГО ХОЗЯЙСТВА
И ПРОДОВОЛЬСТВИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

ГЛАВНОЕ УПРАВЛЕНИЕ ОБРАЗОВАНИЯ,
НАУКИ И КАДРОВОЙ ПОЛИТИКИ

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В. В. Фоменко

АНГЛИЙСКИЙ ЯЗЫК

FUNDAMENTALS OF AGRONOMY

Сборник текстов и упражнений
для студентов, обучающихся по специальностям
1-74 02 01 Агрономия,
1-74 02 02 Селекция и семеноводство

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Автор:
старший преподаватель *В. В. Фоменко*

Рецензент:
кандидат филологических наук, доцент *Н. С. Шатравко*

СОДЕРЖАНИЕ

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Сборник содержит тексты по специальности с комплексом упражнений. Материалы сборника обеспечивают студентов необходимым уровнем лексических навыков, позволяющих эффективно изучать зарубежную литературу и ориентироваться в ней и способствующих систематизации полученных знаний.

Для студентов, обучающихся по специальностям 1-74 02 01 Агрономия, 1-74 02 02 Селекция и семеноводство.

ВВЕДЕНИЕ

Сборник содержит тексты на английском языке и комплекс упражнений, необходимый для совершенствования навыков изучающего чтения и обеспечение студентов необходимым уровнем лексических навыков, позволяющих знакомиться и изучать профессиональную зарубежную литературу.

Сборник включает десять разделов, каждый из которых содержит тексты по специальности, тематический словарь со списком активных словарных единиц, комплекс упражнений для активации изученного материала.

Все задания построены на активной лексике раздела. Контроль понимания прочитанного осуществляется с помощью ответов на вопросы, выбора правильного варианта окончания предложения, дополнения предложений. В сборнике использована и объяснена наиболее частотная терминологическая лексика.

Материалы сборника рекомендованы как для самостоятельной работы студентов, так и для аудиторной работы под руководством преподавателя.

UNIT 1

AGRONOMY

Упражнение 1. Прочитайте и запомните новые слова.

Agronomy агрономия
Science наука
Technology технология
Plants растения
Food еда
Fuel топливо
Fiber волокно
Land restoration восстановление земель
Soil почва
Chemistry химия
Agronomist агроном
Plant breeding селекция растений
Conditions условия
Crop yields урожай
Nutritional value пищевая ценность
Crop сельскохозяйственная культура
Fertilizer удобрение
Growth рост
Manure навоз
Water pollution загрязнение воды
Pesticide пестициды
Organic matter органическое вещество
To contain содержать
Chemicals химикаты

Agronomy is the science and technology of producing and using plants in agriculture for food, fuel, fiber, recreation, and land restoration. Agronomy has come to encompass work in the areas of plant genetics, plant physiology, meteorology, and soil science. It is the application of a combination of sciences like biology, chemistry, economics, ecology, earth science, and genetics. Professionals in the field of agronomy are called agronomists.

Plant breeding involves selective breeding of plants to produce the best crops under various conditions. Plant breeding has increased crop yields and has improved the nutritional value of numerous crops, including corn,

soybeans, and wheat. It has also led to the development of new types of plants. For example, a hybrid grain called triticale was produced by crossbreeding rye and wheat. Triticale contains more usable protein than does either rye or wheat. Agronomy has also been instrumental in fruit and vegetable production research. Additionally, the use of plant breeding has led to reduction in need for fertilizer.

Agronomists use biotechnology to extend and expedite the development of desired characteristic. Biotechnology is often a lab activity requiring field testing of the new crop varieties that are developed.

In addition to increasing crop yields agronomic biotechnology is increasingly being applied for novel uses other than food. For example, oilseed is at present used mainly for margarine and other food oils, but it can be modified to produce fatty acids for detergents, substitute fuels and petrochemicals.

Agronomists study sustainable ways to make soils more productive and profitable throughout the world. They classify soils and analyze them to determine whether they contain nutrients vital to plant growth. Common macronutrients analyzed include compounds of nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. Soil is also assessed for several micronutrients, like zinc and boron. The percentage of organic matter, soil pH, and nutrient holding capacity are tested in a regional laboratory. Agronomists will interpret these lab reports and make recommendations to balance soil nutrients for optimal plant growth.

In addition, agronomists develop methods to preserve the soil and to decrease the effects of erosion by wind and water. For example, a technique called contour plowing may be used to prevent soil erosion and conserve rainfall. Researchers in agronomy also seek ways to use the soil more effectively in solving other problems. Such problems include the disposal of human and animal manure, water pollution, and pesticide build-up in the soil. As well as looking after the soil for future generations to come, such as the burning of paddocks after crop production. Pasture management techniques include no-till farming, planting of soil-binding grasses along contours on steep slopes, and using contour drains of depths up to 1 metre.

Agroecology is the management of agricultural systems with an emphasis on ecological and environmental perspectives. This area is closely associated with work in the areas of sustainable agriculture, organic

farming, and alternative food systems and the development of alternative cropping systems.

Theoretical production ecology tries to quantitatively study the growth of crops. The plant is treated as a kind of biological factory, which processes light, carbon dioxide, water, and nutrients into harvestable products. The main parameters considered are temperature, sunlight, standing crop biomass, plant production distribution, and nutrient and water supply.

Упражнение 2. Соотнесите слова с их определением.

1. science 2. plant 3. nutrient 4. soil 5. agronomist 6. conditions 7. sunlight 8. crop	a) a scientist who studies the relationship between crops and the environment b) the state that something is in c) a substance that is needed to keep a living thing alive and to help it to grow d) the top layer of the earth in which plants, trees grow e) the light from the sun f) knowledge about the structure and behaviour of the natural and physical world, based on facts that you can prove, for example by experiments g) a plant that is grown in large quantities, especially as food h) a living thing that grows in the earth and usually has a stem, leaves and roots, especially one that is smaller than a tree or bush

Упражнение 3. Дополните предложения словами из текста.

1. Agronomy is the science and technology of producing and using_____.
2. Agronomy is the application of a combination of sciences like _____.
3. _____ in the field of agronomy are called agronomists.
4. Plant breeding involves selective breeding of plants to produce _____.
5. Plant breeding has increased _____ and has improved the _____ of numerous crops.
6. _____ is often a lab activity requiring field testing of the new crop varieties that are developed.

7. Oilseed is at present used mainly for margarine and other _____, but it can be modified to produce fatty acids for _____.

8. Common macronutrients analyzed include _____.

9. _____ are tested in a regional laboratory.

10. Agronomists will interpret these lab reports and make _____ to balance soil nutrients for optimal plant growth.

11. Pasture management techniques include _____.

12. Agroecology is _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What is agronomy?
2. What does plant breeding involve?
3. Has plant breeding increased crop yields?
4. What do agronomists use biotechnology for?
5. What is contour plowing?
6. What is agroecology?
7. What does theoretical production ecology study?

SUPPLEMENTARY READING

AGRONOMY

Agronomy is the science and technology of producing and using plants in agriculture for food, fuel, fiber, and land restoration. It is both a humanitarian career and a scientific one. Agronomy has come to encompass work in the areas of plant genetics, plant physiology, meteorology, and soil science.

It is the application of a combination of sciences like biology, chemistry, economics, ecology, earth science, and genetics. Agronomists of today are involved with many issues, including producing food, creating healthier food, managing the environmental impact of agriculture, distribution of agriculture, and extracting energy from plants.

Agronomists often specialise in areas such as crop rotation, irrigation and drainage, plant breeding, plant physiology, soil classification, soil fertility, weed control, and insect and pest control.

Plant breeding involves selective breeding of plants to produce the best crops under various conditions. Plant breeding has increased crop yields and has improved the nutritional value of numerous crops, including corn, soybeans, and wheat. It has also led to the development of new types of plants. For example, a hybrid grain called triticale was produced by

crossbreeding rye and wheat. Triticale contains more usable protein than does either rye or wheat. Agronomy has also been instrumental in fruit and vegetable production research.

Agronomists use biotechnology to extend and expedite the development of desired characteristic. Biotechnology is often a lab activity requiring field testing of the new crop varieties that are developed.

In addition to increasing crop yields agronomic biotechnology is increasingly being applied for novel uses other than food. For example, oilseed is at present used mainly for margarine and other food oils, but it can be modified to produce fatty acids for detergents, substitute fuels and petrochemicals.

Agronomists study sustainable ways to make soils more productive and profitable. They classify soils and analyze them to determine whether they contain nutrients vital to plant growth. The percentage of organic matter, soil pH, and nutrient holding capacity are tested in a regional laboratory. Agronomists will interpret these lab reports and make recommendations to balance soil nutrients for optimal plant growth.

UNIT 2

AGRICULTURE

Упражнение 1. Прочитайте и запомните новые слова.

Agriculture сельское хозяйство
Livestock домашний скот
Development разработка
Subsistence agriculture потребительское сельское хозяйство (с целью получения продуктов для личного потребления)
Plant breeding селекция растений
Pesticides пестициды
Fertilizers удобрения
Crop yields урожайность
Environmental issues экологические проблемы
Deforestation вырубка леса
Fiber волокно
Fuel топливо
Raw materials сырье
Cereals (grains) крупы (зерна)
Vegetables овощи
Fruits фрукты
Oil масло
Fungi грибы

Agriculture is the practice of cultivating plants and livestock. Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that enabled people to live in cities. The history of agriculture began thousands of years ago. After gathering wild grains beginning at least 105,000 years ago, nascent farmers began to plant them around 11,500 years ago. Plants were independently cultivated in at least 11 regions of the world. Industrial agriculture based on large-scale monoculture in the twentieth century came to dominate agricultural output, though about 2 billion people still depended on subsistence agriculture.

Modern agronomy, plant breeding, agrochemicals such as pesticides and fertilizers, and technological developments have sharply increased crop yields, while causing widespread ecological and environmental damage. Selective breeding and modern practices in animal husbandry have similarly increased the output of meat, but have raised concerns about animal welfare and environmental damage. Environmental issues include contributions to global warming, deforestation, antibiotic resistance, and growth hormones in industrial meat production. Agriculture is both a cause of and sensitive to environmental degradation, such as biodiversity loss, desertification, soil degradation and global warming, all of which can cause decreases in crop yield. Genetically modified organisms are widely used, although some are banned in certain countries.

The major agricultural products can be broadly grouped into foods, fibers, fuels and raw materials (such as rubber). Food classes include cereals (grains), vegetables, fruits, oils, meat, milk, fungi and eggs. Over one-third of the world's workers are employed in agriculture, second only to the service sector, although in recent decades, the global trend of a decreasing number of agricultural workers continues, especially in developing countries where smallholding is being overtaken by industrial agriculture and mechanization.

The development of agriculture enabled the human population to grow many times larger than could be sustained by hunting and gathering. Agriculture began independently in different parts of the globe. Wild grains were collected and eaten from at least 105,000 years ago. In the Andes of South America, the potato was domesticated about 9,000 years ago. Cotton was domesticated in Peru by 5,600 years ago, and was independently domesticated in Eurasia.

Scholars have offered multiple hypotheses to explain the historical origins of agriculture, the transition from hunter-gatherer to agricultural societies.

In shifting cultivation, a small area of forest is cleared by cutting and burning the trees. The cleared land is used for growing crops for a few years until the soil becomes too infertile, and the area is abandoned. Another patch of land is selected and the process is repeated. This type of farming is practiced mainly in areas with abundant rainfall where the forest regenerates quickly. This practice is used in Northeast India, Southeast Asia, and the Amazon Basin.

Subsistence farming is practiced to satisfy family or local needs alone, with little left over for transport elsewhere. Intensive farming is cultivation to maximise productivity, with a low fallow ratio and a high use of inputs (water, fertilizer, pesticide and automation). It is practiced mainly in developed countries.

Упражнение 2. Соотнесите слова с их определением.

1. civilization 2. species 3. grain 4. farmer 5. monoculture 6. cultivation 7. infertile 8. mechanization 9. gathering 10. abundant	a) the preparation and use of land for growing plants or crops b) changes made to a process, so that the work is done by machines rather than people c) existing in large quantities; more than enough d) the small hard seeds of food plants such as wheat, rice e) a person who owns or manages a farm f) a group of living organisms consisting of similar individuals capable of exchanging genes or interbreeding g) the process of collecting something h) the practice of growing only one type of crop on a certain area of land i) unable to produce good crops j) a state of human society that is very developed and organized

Упражнение 3. Дополните предложения словами из текста.

1. Agriculture is _____.
2. Industrial agriculture based on large-scale monoculture in the twentieth century came to dominate _____.
3. Environmental issues include _____.

4. Agriculture is both a cause of and sensitive to environmental degradation, such as _____.

5. Food classes include _____.

6. Over one-third of the world's workers are employed in _____, second only to the _____.

7. The development of agriculture enabled the human population to grow many times larger than could be sustained by _____.

8. Scholars have offered multiple _____ to explain the historical origins of agriculture.

9. The cleared land is used for growing crops for a few years until the soil becomes too _____, and the area is _____.

10. Subsistence farming is practiced to _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What is agriculture?
2. What is the role of agriculture in the rise of sedentary human civilization?
3. When did the history of agriculture begin?
4. What is industrial agriculture based on?
5. Which are the major agricultural products?
6. Did agriculture begin independently in different parts of the globe?
7. What is intensive farming?

UNIT 3

CONTEMPORARY STATUS OF AGRICULTURE

Упражнение 1. Прочитайте и запомните новые слова.

Century столетие, век
Water pollution загрязнение воды
Conventional agriculture традиционное сельское хозяйство
Regenerative регенеративный
Movement движение
Research исследование
Demand спрос, потребность
Smallholder agriculture мелкое сельское хозяйство
Hazardous опасный

From the twentieth century, intensive agriculture increased productivity. It substituted synthetic fertilizers and pesticides for labour, but caused increased water pollution, and often involved farm subsidies. In recent years there has been a backlash against the environmental effects of conventional

agriculture, resulting in the organic, regenerative, and sustainable agriculture movements.

The growth of organic farming has renewed research in alternative technologies such as integrated pest management, selective breeding, and controlled-environment agriculture. Recent mainstream technological developments include genetically modified food. Demand for non-food biofuel crops, development of former farm lands, rising transportation costs, climate change, growing consumer demand in China and India, and population growth, are threatening food security in many parts of the world. The International Fund for Agricultural Development posits that an increase in smallholder agriculture may be part of the solution to concerns about food prices and overall food security.

The number of people employed in agriculture and other primary activities (such as fishing) can be more than 80% in the least developed countries, and less than 2% in the most highly developed countries. Since the Industrial Revolution, many countries have made the transition to developed economies, and the proportion of people working in agriculture has steadily fallen.

Agriculture, specifically farming, remains a hazardous industry, and farmers worldwide remain at high risk of work-related injuries, lung disease, noise-induced hearing loss, skin diseases, as well as certain cancers related to chemical use and prolonged sun exposure.

Упражнение 2. Соотнесите слова с их определением.

1) century 2) water pollution 3) conventional agriculture 4) regenerative 5) research 6) mainstream 7) demand 8) smallholder agriculture 9) hazardous 10) land	a) dangerous b) a careful study of a subject, especially in order to discover new facts or information about it c) a small farm operating under a small-scale agriculture model. d) occurs when harmful substances contaminate rivers, lakes, oceans e) the ideas and opinions that are thought to be normal because they are shared by most people f) having the effect of making something develop or grow strong again g) the use of seeds that have been genetically altered using a variety of traditional breeding methods, excluding biotechnology, and are not certified as organic h) a period of 100 years i) the surface of the earth that is not sea j) a very strong request for something

Упражнение 3. Дополните предложения словами из текста.

1. Intensive agriculture caused increased _____.
2. In recent years there has been a backlash against the environmental effects of conventional agriculture, resulting in _____movements.
3. Recent mainstream technological developments include _____ food.
4. Demand for non-food biofuel crops, development of former farm lands, rising transportation costs, climate change, growing consumer demand in China and India, and population growth, are threatening _____ in many parts of the world.
5. An increase in smallholder agriculture may be part of _____ to concerns about food prices and overall food security.
6. The number of people employed in agriculture and other primary activities (such as fishing) can be more than _____ in the least developed countries, and less than _____ in the most highly developed countries.
7. Farming remains a _____ industry, and farmers worldwide remain at _____ of work-related injuries.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What did intensive agriculture cause?
2. Has organic farming renewed research in alternative technologies?
3. What do recent mainstream technological developments include?
4. What is the possible solution to concerns about food prices and overall food security?
5. What is the percentage of people employed in agriculture and other primary activities in the least developed countries? In the most highly developed countries?
6. Does agriculture, specifically farming, remain a hazardous industry?

UNIT 4

CROP CULTIVATION SYSTEMS

Упражнение 1. Прочитайте и запомните новые слова

Available resources доступные ресурсы
Constraints ограничения
Government policy правительственная политика
Acreage площадь
Biodiversity биоразнообразие

Sequentially последовательно
Perennial crops многолетние культуры
Cereals злаки
Legumes бобовые
Forage корм

Cropping systems vary among farms depending on the available resources and constraints; geography and climate of the farm; government policy; economic, social and political pressures; and the philosophy and culture of the farmer.

Shifting cultivation (or slash and burn) is a system in which forests are burnt, releasing nutrients to support cultivation of annual and then perennial crops for a period of several years. Then the plot is left fallow to regrow forest, and the farmer moves to a new plot, returning after many more years (10–20). This fallow period is shortened if population density grows, requiring the input of nutrients (fertilizer or manure). Annual cultivation is the next phase of intensity in which there is no fallow period. This requires even greater nutrient and pest control inputs.

Further industrialization led to the use of monocultures, when one cultivar is planted on a large acreage. Because of the low biodiversity, nutrient use is uniform and pests tend to build up, necessitating the greater use of pesticides and fertilizers. Multiple cropping, in which several crops are grown sequentially in one year, and intercropping, when several crops are grown at the same time, are other kinds of annual cropping systems known as polycultures.

In subtropical and arid environments, the timing and extent of agriculture may be limited by rainfall, either not allowing multiple annual crops in a year, or requiring irrigation. In all of these environments perennial crops are grown (coffee, chocolate) and systems are practiced such as agroforestry. In temperate environments, where ecosystems are predominantly grassland or prairie, highly productive annual farming is the dominant agricultural system.

Important categories of food crops include cereals, legumes, forage, fruits and vegetables. Natural fibers include cotton, wool, hemp, silk and flax. Specific crops are cultivated in distinct growing regions throughout the world.

Top agricultural products, by individual crops (million tonnes) 2011 data	
Sugar cane	1794
Maize	883
Rice	722
Wheat	704
Potatoes	374
Sugar beet	271
Soybeans	260
Cassava	252
Tomatoes	159
Barley	134

Упражнение 2. Соотнесите слова с их определением.

1) arid 2) annual crop 3) perennial crop 4) biodiversity 5) timing 6) multiple cropping 7) irrigation 8) manure	a) the waste matter from animals that is spread over or mixed with the soil to help plants and crops grow b) (of land or a climate) having little or no rain; very dry c) a particular point or period of time when something happens or is planned d) the practice of growing two or more crops in the same piece of land during one growing season instead of just one crop e) a plant that completes its life cycle, from germination to the production of seeds, within one growing season, and then dies f) the practice of supplying water to an area of land through pipes or channels so that crops will grow g) doesn't need to be replanted each year. After harvest it automatically grows back h) the existence of a large number of different kinds of animals and plants which make a balanced environment

Упражнение 3. Дополните предложения словами из текста.

1. Cropping systems vary among farms depending on _____.
2. Shifting cultivation (or slash and burn) is a system in which _____. Further industrialization led to the use of _____, when one cultivar is planted on a large acreage.
3. _____ in which several crops are grown sequentially in one year, and_____, when several crops are grown at the same time, are other kinds of annual cropping systems known as polycultures.
4. In _____ environments, the timing and extent of agriculture may be limited by rainfall, either not allowing multiple annual crops in a year, or requiring irrigation.
5. In _____ environments, where ecosystems are predominantly grassland or prairie, highly productive annual farming is the dominant agricultural system.
6. Natural fibers include _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What does cropping system choice depend on?
2. What is shifting cultivation?
3. What did further industrialization lead to?
4. What is multiple cropping?
5. Speak about important categories of food crops and natural fibers.

UNIT 5

PRODUCTION PRACTICES

Упражнение 1. Прочитайте и запомните новые слова

Tillage Обработка почвы
Soil Почва
To plow пахать
Chemical химический
Harrow борона
Weeds сорняки
Crop rotation севооборот
Culling выбраковка
Crop сельскохозяйственная культура
Composting компостирование
Avoidance Избегание

Resistance сопротивление
Impact влияние
To adopt Принять

Tillage is the practice of breaking up the soil with tools such as the plow or harrow to prepare for planting, for nutrient incorporation, or for pest control. Tillage varies in intensity from conventional to no-till. It may improve productivity by warming the soil, incorporating fertilizer and controlling weeds, but also renders soil more prone to erosion, triggers the decomposition of organic matter releasing CO_2, and reduces the abundance and diversity of soil organisms.

Pest control includes the management of weeds, insects, mites, and diseases. Chemical (pesticides), biological (biocontrol), mechanical (tillage), and cultural practices are used. Cultural practices include crop rotation, culling, cover crops, intercropping, composting, avoidance, and resistance. Integrated pest management attempts to use all of these methods to keep pest populations below the number which would cause economic loss, and recommends pesticides as a last resort.

Nutrient management includes both the source of nutrient inputs for crop production and the method of use of manure produced by livestock. Nutrient inputs can be chemical inorganic fertilizers, manure, green manure, compost and minerals. Crop nutrient use may also be managed using cultural techniques such as crop rotation or a fallow period. Manure is used either by holding livestock where the feed crop is growing, such as in managed intensive rotational grazing, or by spreading either dry or liquid formulations of manure on cropland or pastures.

Water management is needed where rainfall is insufficient or variable, which occurs to some degree in most regions of the world. Some farmers use irrigation to supplement rainfall.

According to a report by the International Food Policy Research Institute, agricultural technologies will have the greatest impact on food production if adopted in combination with each other.

Упражнение 2. Соотнесите слова с их определением.

1) tillage 2) soil 3) plow 4) weeds 5) crop rotation 6) intercropping 7) avoidance 8) rainfall	a) not doing something; preventing something from existing or happening b) the total amount of rain that falls in a particular area in a particular amount of time c) the practice of planting different crops sequentially on the same plot of land to improve soil health, optimize nutrients in the soil, and combat pest and weed pressure d) the process of preparing and using land for growing crops e) growing a crop among plants of a different kind, usually in the space between rows. f) the top layer of the earth in which plants, trees grow g) a large piece of farming equipment with one or several curved blades, (= metal cutting parts) pulled by a tractor or by animals. It is used for digging and turning over soil, especially before seeds are planted. h) a wild plant growing where it is not wanted, especially among crops or garden plants

Упражнение 3. Дополните предложения словами из текста.

1. Tillage varies in intensity from _____ to _____.
2. Tillage may improve productivity by _____.
3. _____ includes the management of weeds, insects, mites, and diseases.
4. Cultural practices include _____.
5. _____ includes both the source of nutrient inputs for crop production and the method of use of manure produced by livestock.
6. Nutrient inputs can be _____.
7. Some farmers use _____ to supplement rainfall.
8. Agricultural technologies will have the greatest impact on food production if adopted _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What is tillage?
2. What does tillage improve?

3. What does pest control include?
4. What do cultural practices include?
5. What does integrated pest management attempt to use?
6. When is water management needed?

UNIT 6

PLANT BREEDING

Упражнение 1. Прочитайте и запомните новые слова.
Crop alteration чередование культур
Humankind человечество
Cross-pollination перекрестное опыление
Lodging жилье
Durability стойкость, выносливость, живучесть
Deficiency дефицит
Insect-resistant устойчивый к насекомым
Soil почва
Damage повреждать
Species вид

Crop alteration has been practiced by humankind for thousands of years, since the beginning of civilization. Altering crops through breeding practices changes the genetic make-up of a plant to develop crops with more beneficial characteristics for humans, for example, larger fruits or seeds, drought-tolerance, or resistance to pests. Significant advances in plant breeding ensued after the work of geneticist Gregor Mendel. His work on dominant and recessive alleles, although initially largely ignored for almost 50 years, gave plant breeders a better understanding of genetics and breeding techniques. Crop breeding includes techniques such as plant selection with desirable traits, self-pollination and cross-pollination, and molecular techniques that genetically modify the organism.

Domestication of plants has, over the centuries increased yield, improved disease resistance and drought tolerance, eased harvest and improved the taste and nutritional value of crop plants. Careful selection and breeding have had enormous effects on the characteristics of crop plants. Plant

selection and breeding in the 1920s and 1930s improved pasture (grasses and clover) in New Zealand. Extensive X-ray and ultraviolet induced mutagenesis efforts (i.e. primitive genetic engineering) during the 1950s produced the modern commercial varieties of grains such as wheat, corn (maize) and barley.

The Green Revolution popularized the use of conventional hybridization to sharply increase yield by creating "high-yielding varieties". Variations in yields are due mainly to variation in climate, genetics, and the level of intensive farming techniques (use of fertilizers, chemical pest control, growth control to avoid lodging).

Genetically modified organisms (GMO) are organisms whose genetic material has been altered by genetic engineering techniques generally known as recombinant DNA technology. Genetic engineering has expanded the genes available to breeders to use in creating desired germlines for new crops. Increased durability, nutritional content, insect and virus resistance and herbicide tolerance are a few of the attributes bred into crops through genetic engineering. For some, GMO crops cause food safety and food labeling concerns. Numerous countries have placed restrictions on the production, import or use of GMO foods and crops. There is ongoing discussion regarding the labeling of foods made from GMOs, and while the EU currently requires all GMO foods to be labeled, the US does not.

Herbicide-tolerant crops are used by farmers worldwide. With the increasing use of herbicide-tolerant crops, comes an increase in the use of glyphosate-based herbicide sprays. In some areas glyphosate resistant weeds have developed, causing farmers to switch to other herbicides. Some studies also link widespread glyphosate usage to iron deficiencies in some crops, which is both a crop production and a nutritional quality concern, with potential economic and health implications.

Other GMO crops used by growers include insect-resistant crops, which have a gene from the soil bacterium, which produces a toxin specific to insects. These crops resist damage by insects. Some believe that similar or better pest-resistance traits can be acquired through traditional breeding practices, and resistance to various pests can be gained through hybridization or cross-pollination with wild species. In some cases, wild species are the primary source of resistance traits; some tomato cultivars that have gained resistance to at least 19 diseases did so through crossing with wild populations of tomatoes.

Упражнение 2. Соотнесите слова с их определением.

1) crop alteration 2) humankind 3) pollination 4) durability 5) deficiency 6) insect 7) soil 8) damage 9) pest	a) the top layer of the earth in which plants, trees, etc. grow b) the quality of being able to last for a long time without breaking or getting weaker c) harmful effects d) an insect or animal that destroys plants, food e) the state of not having, or not having enough of, something that is essential f) any small creature with six legs and a body divided into three parts. Insects usually also have wings. Ants, bees and flies are all insects. g) crop improvement h) the process of pollen entering or being put into a flower or plant so that it produces seeds i) people in general

Упражнение 3. Дополните предложения словами из текста.

1. Crop alteration has been practiced by humankind _____.
2. Altering crops through breeding practices changes the genetic make-up of a plant to develop crops with _____.
3. Significant advances in plant breeding ensued after the work of geneticist _____.
4. Crop breeding includes techniques such as _____.
5. Domestication of plants has increased _____, improved _____.
6. Careful selection and breeding have had enormous effects on the characteristics of _____.
7. The Green Revolution popularized the use of _____.
8. Genetically modified organisms are organisms whose genetic material _____.
9. Genetic engineering has expanded the genes available to breeders to use in creating _____.
10. Increased durability, nutritional content, insect and virus resistance and herbicide tolerance are _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. Does altering crops through breeding practices change the genetic make-up of a plant?
2. What techniques does crop breeding include?
3. What are the benefits of domestication of plants?
4. Has the Green Revolution popularized the use of conventional hybridization?
5. What is a genetically modified organism?
6. Are wild species the primary source of resistance traits?

UNIT 7

ENVIRONMENTAL ISSUES WITH AGRICULTURE

Упражнение 1. Прочитайте и запомните новые слова.

Loss потеря, утрата
Desertification опустынивание
Fossil fuel горючие полезные ископаемые
Global warming глобальное потепление
To decrease уменьшить
Excessive излишний
Natural environment окружающая среда
Freshwater resources пресноводные ресурсы
Algal bloom цветение воды, вызванное массовым развитием водорослей
Anoxia аноксия, отсутствие кислорода
Leaching выщелачивание, промывка
Aquifer водоносный слой

Agriculture is both a cause of and sensitive to environmental degradation, such as biodiversity loss, desertification, soil degradation and global warming, which cause decrease in crop yield. Agriculture is one of the most important drivers of environmental pressures, particularly habitat change, climate change, water use and toxic emissions. Agriculture is the main source of toxins released into the environment, including insecticides, especially those used on cotton. The 2011 Green Economy report stated that agricultural operations produced some 13 per cent of anthropogenic global greenhouse gas emissions. This includes gases from the use of inorganic fertilizers, agro-chemical pesticides, and herbicides, as well as fossil fuel-

energy inputs. Agriculture imposes multiple external costs upon society through effects such as pesticide damage to nature, nutrient runoff, excessive water usage, and loss of natural environment.

Agriculture seeks to increase yield and to reduce costs. Yield increases with inputs such as fertilisers and removal of pathogens, predators, and competitors (such as weeds). Costs decrease with increasing scale of farm units, such as making fields larger; this means removing hedges, ditches and other areas of habitat. Pesticides kill insects, plants and fungi. These and other measures have cut biodiversity to very low levels on intensively farmed land. Effective yields fall with on-farm losses, which may be caused by poor production practices during harvesting and storage.

Land transformation, the use of land to yield goods and services, is the most substantial way humans alter the Earth's ecosystems, and is the driving force causing biodiversity loss. Estimates of the amount of land transformed by humans vary from 39 to 50 %. Land degradation, the long-term decline in ecosystem function and productivity, is estimated to be occurring on 24 % of land worldwide, with cropland overrepresented. Land management is the driving factor behind degradation.

Excessive nutrient enrichment in aquatic ecosystems resulting in algal blooms and anoxia, leads to fish kills, loss of biodiversity, and renders water unfit for drinking and other industrial uses. Excessive fertilization and manure application to cropland, as well as high livestock stocking densities cause nutrient runoff and leaching from agricultural land.

Agriculture accounts for 70 percent of withdrawals of freshwater resources. Agriculture is a major draw on water from aquifers, and currently draws from those underground water sources at an unsustainable rate.

Increasing pressure is being placed on water resources by industry and urban areas, meaning that water scarcity is increasing and agriculture is facing the challenge of producing more food for the world's growing population with reduced water resources. Agricultural water usage can also cause major environmental problems, including the destruction of natural wetlands, the spread of diseases, and land degradation when irrigation is performed incorrectly.

An alternative argument is that the way to "save the environment" and prevent famine is by using pesticides and intensive high yield farming, a view exemplified by a quote heading the Center for Global Food Issues website: 'Growing more per acre leaves more land for nature'. However, critics argue that a trade-off between the environment and a need for food is not inevitable, and that pesticides simply replace good agronomic practices such as crop rotation.

Climate change and agriculture are interrelated on a global scale. Global warming affects agriculture through changes in average temperatures, rainfall, and weather extremes (like storms and heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level. Global warming is already affecting agriculture, with effects unevenly distributed across the world. Future climate change will probably negatively affect crop production in low latitude countries, while effects in northern latitudes may be positive.

Упражнение 2. Соотнесите слова с их определением.

1. Loss 2. Desertification 3. Fossil fuel 4. Global warming 5. To decrease 6. Natural environment 7. Farming 8. Crop production	a) to become smaller in size, number, etc.; to make something smaller in size, number, etc. b) the state of no longer having something or as much of something; the process that leads to this c) the natural world in which people, animals and plants live d) the process of growing agricultural products especially in large quantities e) the process of becoming or making something a desert f) the business of managing or working on a farm g) fuel such as coal or oil that was formed over millions of years from parts of dead animals or plants h) the increase in temperature of the earth's atmosphere that is caused by the increase of particular gases, especially carbon dioxide

Упражнение 3. Дополните предложения словами из текста.

1. Agriculture is both a cause of and sensitive to _____.
2. Agriculture imposes multiple external costs upon society through effects such as _____.
3. Agriculture seeks to increase _____ and to _____ costs.
4. Pesticides kill _____.
5. Effective yields fall with on-farm losses, which may be caused by poor production practices during _____.

6. Excessive fertilization and manure application to cropland cause _____.

7. Climate change and agriculture ____ on a global scale.

8. Global warming affects agriculture through _____.

9. Global warming is already affecting agriculture, with effects _____ distributed across the world.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. Is agriculture sensitive to environmental degradation?
2. Give some examples of environmental degradation.
3. Is engineering the main source of toxins (insecticides) released into the environment?
4. What does yield increase with?
5. What do costs decrease with?
6. What do pesticides kill?
7. What is the best way to save the environment and prevent famine?

UNIT 8

SUSTAINABILITY

Упражнение 1. Прочитайте и запомните новые слова.

To reduce уменьшить
Current текущий
High level высокий уровень
Soil fertility плодородие почвы
To boost crop yields повышать урожайность
Solution решение
Tools инструменты
Carbon sequestration связывание углерода
Technological advancements технологические достижения
To prevent предотвращать
Expansion расширение
Grass трава
Hay сено
Grazing выпас
Consumption потребление
Expansion of agricultural areas расширение сельскохозяйственных угодий

Conservation tillage and buffers reduce soil erosion and water pollution on farms.

Current farming methods have resulted in over-stretched water resources, high levels of erosion and reduced soil fertility. There is not enough water to continue farming using current practices; therefore how critical water, land, and ecosystem resources are used to boost crop yields must be reconsidered. A solution would be to give value to ecosystems and balancing the rights of a variety of users and interests.

Technological advancements help provide farmers with tools and resources to make farming more sustainable. Technology permits innovations like conservation tillage, a farming process which helps prevent land loss to erosion, reduces water pollution, and enhances carbon sequestration. Other potential practices include conservation agriculture, agroforestry, improved grazing, avoided grassland conversion. Current mono-crop farming practices in the United States preclude widespread adoption of sustainable practices, such as 2–3 crop rotations that incorporate grass or hay with annual crops, unless negative emission goals such as soil carbon sequestration become policy.

The agricultural technologies will have the greatest impact on food production if adopted in combination with each other; using a model that assessed how eleven technologies could impact agricultural productivity, food security and trade by 2050, it found that the number of people at risk from hunger could be reduced by as much as 40 % and food prices could be reduced by almost half. The food demand of Earth's projected population, with current climate change predictions, could be satisfied by improvement of agricultural methods, expansion of agricultural areas, and a sustainability-oriented consumer mindset.

Mechanised agriculture: from the first models in the 1940s, tools like a cotton picker could replace 50 farm workers, at the price of increased use of fossil fuel. Since the 1940s, agricultural productivity has increased

dramatically, due largely to the increased use of energy-intensive mechanization, fertilizers and pesticides. The vast majority of this energy input comes from fossil fuel sources. The Green Revolution transformed agriculture around the globe, with world grain production increasing significantly (between 70 % and 390 % for wheat and 60 % to 150 % for rice, depending on geographic area) as world population doubled. Heavy reliance on petrochemicals has raised concerns that oil shortages could increase costs and reduce agricultural output.

Industrialized agriculture depends on fossil fuels in two fundamental ways: direct consumption on the farm and manufacture of inputs used on the farm. Direct consumption includes the use of lubricants and fuels to operate farm vehicles and machinery.

Упражнение 2. Соотнесите слова с их определением.

1) farm vehicles 2) fossil fuels 3) price 4) grazing 5) to reduce 6) soil fertility 7) to boost crop yields 8) solution 9) tool 10) consumption	a) to make something less or smaller in size, quantity, price, etc.; to become less or smaller in size, quantity, etc. b) the quality in land of making plants grow well c) the amount of money that you have to pay for something d) land with grass that cows, sheep, etc. can eat e) to increase the amount of agricultural production f) a way of solving a problem or dealing with a difficult situation g) fuel such as coal or oil, that was formed over millions of years from the remains of animals or plan h) the act of using energy, food or materials; the amount used i) a thing that is used for transporting people or goods from one place to another in agriculture j) an instrument such as a hammer, screwdriver, saw, etc. that you hold in your hand and use for making things, repairing things, etc.

Упражнение 3. Дополните предложения словами из текста.

1. _____ reduce soil erosion and water pollution on farms.
2. Current farming methods have resulted in _____.
3. Technological advancements help provide farmers with tools and resources to make farming _____.

4. The food demand of Earth's projected population, with current climate change predictions, could be satisfied by _____.

5. Agricultural productivity has increased dramatically, due largely to _____.

6. The Green Revolution _____ agriculture around the globe.

7. Heavy reliance on petrochemicals has raised concerns that oil shortages could increase _____ and reduce _____.

8. Industrialized agriculture depends on fossil fuels in two fundamental ways: _____ and _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. Do conservation tillage and buffers reduce soil erosion and water pollution on farms?
2. What do current farming methods have resulted in?
3. Is there enough water to continue farming using current practices?
4. What do technological advancements help provide farmers with?
5. Do the agricultural technologies will have the greatest impact on food production if adopted in combination with each other?
6. How did Green Revolution transform agriculture around the globe?
7. In what ways does industrialized agriculture depend on fossil fuels?

UNIT 9

CLASSICAL PLANT BREEDING

Упражнение 1. Прочитайте и запомните новые слова.

To propagate размножать
Desirable characteristics желаемые характеристики
To eliminate устранить
A mildew плесень
High-yielding высокоурожайный
Susceptible восприимчивый
Progeny Потомство
Homologous recombination гомологичная рекомбинация
Nature природа

One major technique of plant breeding is selection, the process of selectively propagating plants with desirable characteristics and eliminating or "culling" those with less desirable characteristics.

Another technique is the deliberate interbreeding (crossing) of closely or distantly related individuals to produce new crop varieties or lines with desirable properties. Plants are crossbred to introduce traits/genes from one variety or line into a new genetic background. For example, a mildew-resistant pea may be crossed with a high-yielding but susceptible pea, the goal of the cross being to introduce mildew resistance without losing the high-yield characteristics. Progeny from the cross would then be crossed with the high-yielding parent to ensure that the progeny were most like the high-yielding parent, (backcrossing). The progeny from that cross would then be tested for yield (selection, as described above) and mildew resistance and high-yielding resistant plants would be further developed. Plants may also be crossed with themselves to produce inbred varieties for breeding.

Classical breeding relies largely on recombination between chromosomes to generate genetic diversity. The classical plant breeder may also make use of a number of *in vitro* to generate diversity and produce hybrid plants that would not exist in nature.

Traits that breeders have tried to incorporate into crop plants include:

1. Improved quality, such as increased nutrition, improved flavor, or greater beauty
2. Increased yield of the crop
3. Increased tolerance of environmental pressures (extreme temperature, drought)
4. Resistance to viruses, fungi and bacteria
5. Increased tolerance to insect pests
6. Increased tolerance of herbicides
7. Longer storage period for the harvested crop

Modern plant breeding may use techniques of molecular biology to select, or in the case of genetic modification, to insert, desirable traits into plants. Application of biotechnology or molecular biology is also known as molecular breeding.

Sometimes many different genes can influence a desirable trait in plant breeding. The use of tools such as molecular markers or DNA fingerprinting can map thousands of genes. This allows plant breeders to screen large populations of plants for those that possess the trait of interest. The screening is based on the presence or absence of a certain gene as determined by laboratory procedures, rather than on the visual identification of the expressed trait in the plant. The purpose of plant genome analysis is to identify the location and function of various genes within the genome.

If all of the genes are identified it leads to genome sequence. All plants have varying sizes and lengths of genomes with genes that code for different proteins, but many are also the same. If a gene's location and function is identified in one plant species, a very similar gene likely can also be found in a similar location in another related species genome.

Упражнение 2. Соотнесите слова с их определением.

1) gene 2) backcrossing 3) genetic diversity 4) plant breeder 5) in vitro technique 6) quality 7) yield 8) tolerance 9) absence 10) analysis	a) crossing of a hybrid with one of its parents or an individual genetically similar to its parent, to achieve offspring with a genetic identity closer to that of the parent. b) work performed outside of a living organism c) the non-existence or lack of d) Scientist who changes the traits of plants in order to produce desired characteristics e) the total amount of crops produced f) detailed examination of the elements or structure of something g) the capacity to endure continued subjection to something such as environmental conditions without adverse reaction h) the total number of genetic characteristics in the genetic makeup of a species i) a unit inside a cell that controls a particular quality in a living thing that has been passed on from its parents j) the standard of something when it is compared to other things like it; how good or bad something is

Упражнение 3. Дополните предложения словами из текста.

1. Selection is the process of _____.
2. Plants are crossbred to introduce traits/genes from one variety or line into a new genetic background.
3. Plants may also be crossed with themselves to produce _____.

4. Classical breeding relies largely on _____.
5. Traits that breeders have tried to incorporate into crop plants include _____.
6. Modern plant breeding may use techniques of _____.
7. Application of biotechnology or molecular biology is also known as _____.
8. The screening is based on _____.
9. The purpose of plant genome analysis is to _____.

Упражнение 4. Ответьте на вопросы по содержанию текста.
1. What is selection?
2. What is the deliberate interbreeding?
3. What is the purpose of crossing plants?
4. What is molecular breeding?
5. Is plant breeding a long process?

UNIT 10

BREEDING AND FOOD SECURITY

Упражнение 1. Прочитайте и запомните новые слова.

To thrive процветать
Lack недостаток
Arable land пахотная земля
Harsh cropping conditions суровые условия возделывания
To maintain поддерживать
Food security продовольственная безопасность
To provide предоставлять
Sufficient достаточный
Nutrition питание
Drought засуха
Tolerance толерантность, устойчивость
Production per capita производство на душу населения
Forage корм
To combat сражаться
Desiccation высыхание

For agriculture to thrive in the future, changes must be made to address arising global issues. These issues are the lack of arable land, increasingly

harsh cropping conditions and the need to maintain food security, which involves being able to provide the world population with sufficient nutrition. Crops need to be able to mature in multiple environments to allow worldwide access, which involves solving problems including drought tolerance. It has been suggested that global solutions are achievable through the process of plant breeding, with its ability to select specific genes allowing crops to perform at a level which yields the desired results.

With an increasing population, the production of food needs to increase with it. It is estimated that a 70 % increase in food production is needed by 2050. But with the degradation of agricultural land, simply planting more crops is no longer a viable option. New varieties of plants can in some cases be developed through plant breeding that generate an increase of yield without relying on an increase in land area. An example of this can be seen in Asia, where food production per capita has increased twofold. This has been achieved through not only the use of fertilizers, but through the use of better crops that have been specifically designed for the area.

Plant breeding can contribute to global food security as it is a cost-effective tool for increasing nutritional value of forage and crops. Improvements in nutritional value for forage crops from the use of analytical chemistry and rumen fermentation technology have been recorded since 1960; this science and technology gave breeders the ability to screen thousands of samples within a small amount of time, meaning breeders could identify a high performing hybrid quicker.

Plant breeding of hybrid crops has become extremely popular worldwide in an effort to combat the harsh environment. With long periods of drought and lack of water or nitrogen stress tolerance has become a significant part of agriculture. Plant breeders have focused on identifying crops which will ensure crops perform under these conditions; a way to achieve this is finding strains of the crop that is resistance to drought conditions with low nitrogen. It is evident from this that plant breeding is vital for future agriculture to survive as it enables farmers to produce stress resistant crops hence improving food security. In countries that experience harsh winters such as Iceland, Germany and further east in Europe, plant breeders are involved in breeding for tolerance to frost, continuous snow-cover, frost-

drought (desiccation from wind and solar radiation under frost) and high moisture levels in soil in winter.

Упражнение 2. Соотнесите слова с их определением.

1) to thrive 2) lack 3) arable land 4) harsh cropping conditions 5) food security 6) nutrition 7) drought 8) tolerance 9) production per capita 10) to combat 11) desiccation	a) the removal of moisture from something b) a prolonged period of abnormally low rainfall, leading to a shortage of water c) the state of not having something or not having enough of something d) drought, too much salt in the soil or extreme temperatures e) the capacity to endure continued subjection to something such environmental conditions without adverse reaction f) the state of having reliable access to a sufficient quantity of affordable, nutritious food. g) to become strong, healthy, etc. h) food i) production per person j) take action to reduce or prevent (something bad or undesirable) k) the land under temporary agricultural crops

Упражнение 3. Дополните предложения словами из текста.

1. For agriculture to thrive in the future, changes must be made to address _____.
2. The ecological issues are _____.
3. _____ need to be able to mature in multiple environments to allow worldwide access.
4. It has been suggested that global solutions are achievable through the process of _____.
5. With an increasing population, the production of food needs to _____ with it.

6. It is estimated that a ____ increase in food production is needed by _____.

7. But with the degradation of agricultural land, simply planting more crops is _____.

8. New varieties of plants can in some cases be developed through plant breeding that generate an increase of yield without relying on _____.

9. Plant breeding can contribute _____ as it is a cost-effective tool for increasing nutritional value of forage and crops.

10. Plant breeding of _____ has become extremely popular worldwide in an effort to combat the harsh environment.

Упражнение 4. Ответьте на вопросы по содержанию текста.

1. What measures should be taken to make agriculture thrive in the future?
2. Why do crops need to be able to mature in multiple environments?
3. Why does the food production need to be increased?
4. Is simply planting more crops a viable option?
5. Can plant breeding contribute to global food security? Why?
6. How can breeders identify a high performing hybrid?
7. Why is plant breeding of hybrid crops extremely popular worldwide?

SUPPLEMENTARY READING

SOIL

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. Earth's body of soil, called the pedosphere, has four important functions:

- as a medium for plant growth
- as a means of water storage, supply and purification
- as a modifier of Earth's atmosphere
- as a habitat for organisms

All of these functions, in their turn, modify the soil and its properties.

Soil is also commonly referred to as earth or dirt; some scientific definitions distinguish dirt from soil by restricting the former term specifically to displaced soil.

The pedosphere interfaces with the lithosphere, the hydrosphere, the atmosphere, and the biosphere. The term pedolith, used commonly to refer to the soil, translates to ground stone in the sense fundamental stone, from the ancient Greek πέδον 'ground, earth'. Soil consists of a solid phase of minerals and organic matter (the soil matrix), as well as a porous phase that

holds gases (the soil atmosphere) and water (the soil solution). Accordingly, soil scientists can envisage soils as a three-state system of solids, liquids, and gases.

Soil is a product of several factors: the influence of climate, relief (elevation, orientation, and slope of terrain), organisms, and the soil's parent materials (original minerals) interacting over time.[5] It continually undergoes development by way of numerous physical, chemical and biological processes, which include weathering with associated erosion. Given its complexity and strong internal connectedness, soil ecologists regard soil as an ecosystem.

Soil science has two basic branches of study: edaphology and pedology. Edaphology studies the influence of soils on living things. Pedology focuses on the formation, description (morphology), and classification of soils in their natural environment.

BASIC CLASSIFICATIONS OF CROPS

Season сезон, пора года
Sowing посев
Classification классификация
Origin источник, происхождение
Purpose цель
Industrial промышленный
Supplement добавка
Advantage преимущество

The development of agriculture and industry involved a vaster usage of plants than just for eating or feeding domestic animals. Furthermore, when mankind satisfied its primary needs in food and industrial products, it started thinking about the aesthetic side as well. Thus, various plants were used in home décor and landscape design.

There are several classifications of crops:

Season of sowing (spring or fall).

Origin of plants (local or foreign).

Purpose of growing. This classification falls into six basic groups:

Food crops – for human needs (e.g. wheat, maize, legumes, rice, potatoes, tomatoes).

Feed crops – for cattle or livestock consumption (e.g. barley, beets, grasses for domestic animals to graze and store as hay or silage).

Fiber crops – for the sake of fibers used in clothes, bedding, industry, and household (hemp, cotton, flax, bamboo).

Oil crops – for oil manufacturing either for machinery fuel (rape) or food industry (sunflower, olives).

Ornamental crops – for home decoration and landscape design (garden or pot flowers and bushes).

Industrial crops – for industrial manufacturing (rubber).

The described classification of crops doesn't embrace crop types strictly, meaning that if one plant belongs to one category, it can't belong to another. The exceptions probably make only the two last groups, when industrial rubber can't be used for food and garden flowers are often beautiful but poisonous.

In the rest of the cases, the groups are interchangeable. Thus, wheat and oats can be used both as food and feed crops, depending on their quality. Flax seeds are a useful dietary supplement while its fibers are utilized in textiles. Sugarcane is the source of edible sugar and alcohol for bioethanol.

A few words should be mentioned here about GMO foods as a specific genetically engineered crop type. They are less subject to diseases, more productive and require less fertilizing. However, it is doubtful if they really do much good for people, while the advantage of organic farming for human health can't be denied.

GRAIN

A grain is a small, hard, dry seed - with or without an attached hull or fruit layer - harvested for human or animal consumption. A grain crop is a grain-producing plant. The two main types of commercial grain crops are cereals and legumes.

After being harvested, dry grains are more durable than other staple foods, such as starchy fruits (plantains, breadfruit, etc.) and tubers (sweet potatoes, cassava, and more). This durability has made grains well suited to industrial agriculture, since they can be mechanically harvested, transported by rail or ship, stored for long periods in silos, and milled for flour or pressed for oil. Thus, major global commodity markets exist for maize, rice, soybeans, wheat and other grains but not for tubers, vegetables, or other crops.

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