занятиях (как лекционных, так и семинарских) широко используются компьютерные презентации. Компьютер оказывается и неоценимым помощником при обработке результатов студенческого рейтинга. Применение компьютерных технологий способствует интенсификации образовательного процесса в ходе изучения дисциплины «Экологическая биотехнология», а также способствует профессиональной подготовки будущего специалиста-эколога к самостоятельной практической деятельности.

Следует также отметить, что экологическое образование включает поиск новых форм и методов активизации экологического образования студентов. Одним из многообразных путей достижения этой цели является привлечение студентов к исследовательской работе путем выполнения и написания курсовых и дипломных работ, темы которых связаны с биотехнологическими аспектами охраны окружающей среды. Актуальность выполняемых работ заключается в том, что большинство биотехнологических разработок прямо или косвенно связано с глобальными проблемами, стоящими перед современной цивилизацией, одной из которых является загрязнение окружающей среды. Эта проблема и пути ее решения с точки зрения биотехнологических подходов освящена в ряде дипломных работ студентов бакалавров и магистров по специальности «Экология».

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Мақалада «Экологиялық биотехнология пәнін жоғары оқу орындарының экология мамандықтарын дайындауды ендірі, оның негізгі бағыттары және өзекті мәселелері талданады.

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In article the discipline role «Ecological biotechnology» in preparation of experts of ecologists in High Schools, its basic directions and actual problems is considered.

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BIOTECHNOLOGY: ACHIEVEMENTS AND CONSEQUENCES.

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The development of new biological tools in the second half of the 20th century gave immense possibilities for genetic engineering and creating new organisms with desirable characteristics. New horizons emerged for agriculture, medicine and environmental area. More than twenty years have passed since the first genetically engineered organisms have been planted in Canada and the USA in the late 1980s. In this article we have analyzed achievements and consequences of the biotechnological applications in agriculture and environmental area.

Genetic engineering in basic sciences

The primary application of genetic engineering has been in the field of basic science for cloning key genes in order to understand their functions. Success in sequencing of individual genes allowed studying genes' networks and signaling pathways and, eventually, the mechanisms of functioning of the living organism. Biomedical engineering has been applied to cure human diseases (gene therapy), sequencing of whole genomes of different species, and later cloning of animals and manipulations with stem cells. The Human Genome Project, officially started in 1990, was and completed in 2003, revealing key genes associated with at least 30 diseases. The first genetically modified organisms (GMO) have been used solely for basic biological research needs. The transgenic mice research has provided wide range of applied biomedical studies to understand signaling mechanisms and drug screening to treat different diseases.

Plant genes encoding biologically active proteins and their specific regions have been studied to understand plant responses to biotic and abiotic stresses. The break though was made with sequencing *Arabidopsis thaliana* genome and using it as a model plant system for functional genomics studies. New techniques using so-called gain- and loss-of-function T-DNA mutants allowed to study gene's function at the genetic and protein levels. Mutation of a single *Arabidopsis* gene can reveal the functional activity of a missing gene which could be then confirmed by producing of transgenic *Arabidopsis* plants over-expressing the gene of interest. Much has been done in this field to understand plants response to different pathogens, draught, salinity, extreme temperatures etc. The Arabidopsis model has been successfully used to understand oxidative stress network induced by pathogens and harsh environmental conditions.

Genetically Modified Organisms for agriculture

Advanced approaches have been considered in agriculture for improvement of plant products' qualities, their fortification with important nutrients, strengthening plants abilities to resist microbial and viral diseases. A number of GMO have been created for commercial use claiming that they will help to reduce the use of herbicides and pesticides. GM herbicide-resistant crops such as Roundup Ready crops (soy, corn, cotton, sugarbeets, alfalfa and canola) can survive spraying with Monsanto's Roundup herbicide, the most widely used deadly herbicide in the world. Recently, new GM herbicide-tolerant crops have been developed by Dow AgroSciences, which can resist the infamous herbicide 2,4-D, a major ingredient in the notorious Agent Orange chemical defoliant used during the Vietnam War [1]. The Agent Orange ingredient is linked to human diseases from cancer to immunosuppression, reproductive damage to neurotoxicity [2]. Another danger is that this leads to herbicide-resistant weeds. Indeed, the course of evolution has shown that new organisms via mutation have emerged to resist and survive. Andrew Kimbrell, director of the Center for Technology Assessment in Washington, believes, "Biological pollution will be the environmental nightmare of the 21st century" [3]. "Biological pollution is an entirely different model, more like a disease. Is Monsanto going to be held legally responsible when one of its transgenes creates a superweed or resistant insect?" Genetically engineered crops that can resist pesticides produce their own pesticides. GM potato known as the New Leaf Superior was from Bacillus thuringiensis, the soil bacterium that produces the organic insecticide. Expression of its own Bt insecticide made it resistant from the Colorado potato beetle [3]. Interestingly, the Bt potato is classified as pesticides by the EPA. The quality such as insect- resistance is good only for commercial use but not for family farmers and is threatening for the environment and human health. Another, neither less threatening problem is the spread of artificially expressed genes from GM plants into the wild environment. Pollen of GM crops can pass herbicide resistance genes to weedy relatives, affect the evolution of pests and wildlife, and the food chains of the whole ecosystem.

The latest news places the last drop in GM crops failure. Scientists at Purdue University demonstrated an adverse impacts of clothianidin, an insecticide used as a seed treatment on GM corn and other crops on honey bee health [4]. It was found in dead bees and in pollen collected by bees. Neil Carman, Ph.D., says: "US researchers have documented major adverse impacts from clothianidin seed treatments in corn on honey bee health." "Because of the vital role played by honey bees in crop pollination, honey bee demise threatens the production of crops that produce one-third of American diets, including nearly 100 fruits and vegetables. The value of crops pollinated by bees exceeds $15 billion in the US alone." Scientists warn that insertion of one gene can hardly affect the crops yield which is genetically controlled by a gene complex. Moreover, unpredicted challenges have revealed the complexity in the field of plant engineering. For example, the successful production of Bt corn. The bt toxin produced by these GM crops are far stronger than any found in nature, and are produced throughout the plant. Consuming of adulterated rapeseed oil in 1983 caused death of hundreds people in Spain [5]. The fact that the adulterated rapeseed oil was tested on rats indicates that testing procedures for genetically modified food including rodent tests are not safe and sufficient for humans.

Scientists are concerned with the consequences that can arise in the future because of unpredictable genetic modification of the introduced gene at a single site or multiple sites of the plant genome referred to as pleiotropic effects causing various phenotypic changes. Safety Evaluation of Genetically Modified Foods of the Division of Food Chemistry and Technology and Division of Contaminants Chemistry [6] states, "Undesirable phenotypes may include, for example, poor growth, reduced levels of nutrients, increased levels of natural toxicants, etc. Pleiotropic effects occur in genetically engineered plants obtained with Agrobacterium-mediated transformation at frequencies up to 30%." "Residues of plant constituents or toxicants in meat and milk products may pose human food safety problems. For example, increased levels of glucosinolates or erusic acid in rapeseed may produce a residue problem in edible products," writes Gerald B. Guest, Director of the Center for Veterinary Medicine [7].

Manipulations with viral genetic material have been investigated to create modified viruses such as cauliflower mosaic virus plants resistant to viral diseases. The unexpected consequences of such genetic manipulations are little known. Another warning appeal of scientists, farmers, and environmental activists is that genetic engineering without careful study can create unprecedented problems to our society. Precautious studies are required before taking a single step in this direction, otherwise living organisms as the products of some three billion years of evolution will be lost forever from the face of the Earth." Dr. George Wald from Harvard University, the 1967 Nobel Laureate in Medicine, writes, "It is all too big and is happening too fast. So this, the central problem, remains almost unconsidered. It presents probably the largest ethical problem that science has ever had to face. Our morality up to now has been to go ahead without restriction to learn all that we can about nature. Restructuring nature was not part of the bargain. For going ahead in this direction may be not only unwise, but dangerous. Potentially, it could breed new animal and plant diseases, new sources of cancer, novel epidemics" [8].

However, the Food and Drug Administration (FDA) officials do not share those concerns. The the Monsanto Director of Corporate Communications Phil Angell, states that "Monsanto should not have to vouchsafe the safety of biotech food. Out interest is in selling as much of it as possible." [9]. GM plants resistant to commercial herbicides were first planted in Canada and the USA in the late 1980s. Since large-scale commercial cultivation has been approved in the mid 1990s, the USA is the largest producer of GM crops in the world. Nowadays over 80% of global GMO production is limited to the USA, Canada, Brazil, and Argentina.

The genetically modified (GM) plants have been promised to increase crops yield to fight poverty and hunger in the poorest countries of the third world. To increase crops yield farmers have to use more fertilizer, and pesticide which destroy soil, pollute the ground water, intoxicate food, and, eventually, threaten human health. Monsanto proclaimed that ''current agricultural technology is not sustainable" promising to create GM plants that can fight all environmental adversities themselves expressing endogenous genes with desired qualities. "Biotechnology is the single most promising approach to feeding a growing world population while reducing damage to the environment", claims Phil Angell, the Monsanto Director of Corporate Communications [10]. How do Biotech companies help to developing countries? They oblige farmers to sign contract that they will not save, resell, or exchange seed. That means that every year the farmers have to buy the seeds again from Biotech companies. These cabal contracts put poor farmers from developing countries into dependence from Biotech firms and give a rise to a modern form of slavery. Loss of yield in India caused enormous debt and pushed farmers to commit suiside [11]. Unprecedentedly, India accused the US-based Biotech company Monsanto in biopiracy for stealing its indigenous eggplant in order to create GM vegetable without permission and thus violating India's Biodiversity Act. Recent attempts to introduce GM rice to China have also failed [12]. Scientists are concerned that biotechnology cannot provide secure food and reduce poverty in the developing world [13].

Biofuel and environmental applications

According to the U.S. Department of Energy fossil fuel-based consumption could be reduced by 30% by 2030. Rising demand for biofuel has produced new techniques such as ethanol production by genetically modified corn and soybean resistant to pests and drought.

The GM maize (corn) was the only food crop in Europe allowed for cultivation. Greenpeace confirms the commercial failure of GM food in Europe, where seven EU countries have imposed ban on MON810 [14]. Of about 179 million hectares of the EU's agricultural land, only about 0.06% was used in 2011 to grow GM food. The French government banned the insect-resistant MON810 maize (corn) in 2012 and beyond as being dangerous for health and the environment [15].

Recently, a new technology using genetically modifying *Escherichia coli* bacteria and algae for producing next-generation biofuels has been developed [16,17]. This strategy could lead to mass production of these harmless for the environment biofuels from *E.coli* and other microorganisms. New approaches reveal numerous possibilities for industrial for biotech applications such as production of biodegradable plastics and other environmental issues. The potential of biotechnology can be used to prevent and remove pollution and wastes. In particular, the hydrocarbon-degrading activities of the so-called hydrocarbonoclastic bacteria can be applied to clean oil spills [18]. More approaches are awaiting for application to maximize economic input through bio-degradable waste and by-products generation, and potentially energy-saving bio-processes.

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Разработка новых биологических средств во второй половине XX века дает огромные возможности для генной инженерии и создания новых организмов с желательными характеристиками. Появились новые горизонты для сельского хозяйства, медицины и в экологической области. Более 20 лет прошло с тех пор, когда первые генетически модифицированные организмы были посажены, в конце 1980-х в Канаде и США. В данной статье мы анализируем достижения и последствия применения биотехнологии в сельском хозяйстве и экологической области.

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XX ғасырдың екінші жартысындағы жаңа биологиялық қосылыстарды жасау технологияларының дамуы гендік инженерия үшін және қажетті белгілерімен ерекшеленетін организмдерді дүниеге келтіруге үлкен мүмкіндіктер береді. Ауыл шаруашылығы, медицина және экология салалары үшін жаңа белестер ашылды. 1980 жылдардың соңында Канада мен АҚШ-та, генетикалық жетілдірілген алғашқы организмдердің алынғанынан бері 20 жылдан астам уақыт өтті. Аталмыш мақалада ауыл шаруашылығы мен экология салаларына биотехнологияның жетістіктерінің әсері мен оларды қолданудың салдары қарастырылады.

Р.Б. Жакешбаева, С.И. Альмурзаева

МҰНАЙМЕН ЛАСТАНҒАН ТОПЫРАҚТЫҢ АУЫЛШАРУАШЫЛЫҒЫНДА МАҢЫЗДЫ ӨСІМДІКТЕРГЕ ӘСЕРІН АНЫҚТАУ

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Жұмыста әртүрлі концентрацияда мұнай және оның өнімдерімен ластанған топырақтағы ауылшаруашылығында маңызды өсімдіктердің өсуімен, олардың жерасты және жерүсті мүшелерінің дамуына, сонымен қатар мұнаймен ластанған топырақтың және сол топырақта өсірілген өсімдіктердің құрамындағы ауыр металдарға сараптама жүргізілді.

Қазақстанның батыс өңірінде табиғатты негізгі техногенді ластаушылар мұнай және оның өнімдері болғандықтан бұл мәселе осы аймақта өзекті болып отыр. Қоршаған ортаны әртүрлі улы қосылыстармен, соның ішінде мұнай және оның өнімдерінен қорғау, төтенше маңызды, экологиялық мәселе болып отыр. Мұнайды құбырлар арқылы тасымалдау, мұнай саңылауларын бұрғылау кезінде, мұнайды өндіріс орнында өндіру кезінде және т.б. жағдайда қоршаған ортаның көмірсутектермен ластануы орын алады. Мұнай құбырларын салудың флористикалық құрамға әсерін зерттегенде мұнай құбырларын салудың жанама әсерлері негізінен көп сипаттамаға ие және топырақтың механикалық бүлінуі мен тамырлы өсімдіктердің түгелдей жойылуына әсер етеді [1,2].

Тәжірибе лабораториялық жағдайда, таза топырақты 1.5%, 3.0% және 6.0% концентрацияда шикі мұнаймен ластау арқылы жүргізілді. Топырақтың жалпы фитоуыттылығын Гродзинский А.М. ұсынған әдістеме арқылы анықтадық [3]. Ластанған топырақтың фитоуыттылығын бағалауға арналған сынақ-өсімдік ретінде: қара бидай мен бидайдың будандары Тритикале *(Triticesecale №352)*, күздік қара бидай *(Secale cereale)*, жергілікті *(Triticum)* бидай сорттары-«Оренбургская №10» және «Қарғалы №11», сонымен қатар далалық бидайық (*Agropyron desertorum)* өсімдіктері қолданылды. Мұнаймен ластанған топырақ және өсімдіктер құрамындағы ауыр металдардың концентрациясы атомды-адсорбциялық спектрометриялық әдіспен «ИСТ-ЭКО» ЖШС-нің зерттеу лабораториясында анықталды [4]. Мұнаймен ластанған топырақ пен өсімдіктердің химиялық құрамына зерттеу жүргізу кезінде төмендегідей нәтижелерге қол жеткіздік. Тритикале өсімдігі егілген топырақта қорғасынның мөлшері бақылаудың өзінде ШМК-дан 2 есе жоғары (2.15±0.906г/кг), өсу дәрежесі келесідей: 1.5%≤ бақылау ≤ 3.0% ≤ 6.0%. Мыстың топырақтағы концентрациясының жоғарылауы келесі ретпен жүрді: 3.0%≤бақылау ≤1.5%≤6.0% (2.3±0.644г/кг). Мырыштың мөлшері келесідей көрсеткішті көрсетеді: бақылау ≤ 3.0% ≤ 1.5% ≤ 6.0% (12.3±0.742 г/кг). Никельдің мөлшері: бақылау ≤1.5% ≤ 3.0% ≤ 6.0 (19.6±0.949г/кг) болады. Хром мөлшеріне ауылшаруашылық мақсатта пайдаланатын топыраққа ортақ ШМК бекітілмеген. Біздің тәжірибемізде хромның мөлшері төмендегідей: бақылау≤3.0%≤1.5%≤6.0% (9.12±0.443г/кг). Қара бидай егілген топырақ сынамаларында мұнай дозасы жоғарылаған сайын ауыр