GMOs: Progress or Peril

Spring 2018 - UEP 294-10
Urban & Environmental Policy & Planning
Time/day Tuesdays 4-6:30PM Instructor: Professor Sheldon Krimsky

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The course covers the history of genetically modified crops, the impact of GMOs on agriculture, plant biotechnology's use of pesticides and herbicides; the patenting of seeds; debate over labeling GMOs; health and environmental risk assessment; regulatory policies in the US and Europe. Specific cases include: flavr Savr Tomato, ice-minus; bovine growth hormone (BGH); herbicide resistant crops; Golden Rice, insect and disease resistant crops, transgenic animals. The course will investigate the locus of current controversies, examine whether there is consensus within science for the areas in public dispute, and explore the roles of politics, economics, and ethics in the GMO controversy.

Core Questions:

In what ways does agricultural biotechnology differ from traditional crop breeding?

Are these differences relevant to safety, quality, risk assessment, and productivity?

Under what conditions are GMOs reviewed by agencies or producers for health and environmental safety?

What are the arguments for and against that GMOs should be treated differently than crops produced by traditional breeding?

Are transgenic crops more productive than crops produced by traditional breeding?

Do transgenic crops use fewer or more chemical herbicides and pesticides?

What are the arguments for and against that view that ransgenic crops are a step toward reducing world hunger?

Books:

S. Krimsky & R. Wrubel, *Agricultural Biotechnology & the Environment*. Univ. Illinois Press.

N. Federoff & N.M. Brown, *Mendel in the Kitchen.* Joseph Henry Press.

National Academies of Sciences, Engineering and Medicine, *Genetically Engineered Crops: Experiences and Prospects.* 2016.

Sess. 1 Jan. 26 **Introduction**

Historical background of GMOs; birth of gene splicing 1973-1980; recombinant DNA controversy; early debates about transgenic species.

Video: Cambridge rDNA controversy.

Sess. 2 Feb. 2 Birth of Agricultural Biotechnology

Distinction between traditional agricultural technologies and modern ag-biotechnology; early developments of transgenic crops and microoganisms; ice-minus; flavr savr tomato; hybridization; chemical and radiation mutation of plants.

Readings

Krimsky/Wrubel, Ch. 1 Technological Innovations in Agriculture

Federoff/Brown, Ch, 5, Tinkering with Evolution, pp.85-105; Ch. 6 Making a Chimera, pp. 107-127.

P.Gepts. A comparison between crop domestication, classical plant breeding, and genetic *engineering Crop Science* 42:1780-1790 (November-December 2002).

Sess. 3 Feb. 9 **Bovine Growth Hormone**

Increasing milk production through bacterially produced bovine growth hormone; gene splicing turns BGH into a milk producing technology; controversy and opposition; reaction by dairy farmers. Adoption of BGH in the US and other countries. Postulated risks to cows; risks to humans.

Video:

Readings

Krimsky/Wrubel Ch. 9 Animal Growth Hormones

Bauman, Dale E. Bovine Somatotropin: Review of an Emerging Animal Technology. *Journal of Dairy Science* 75: 3432-3451 (1992).

Nachman, Keeve, E. Hormone Use in Food Animal Production: Assessing Potential Dietary Exposures and Breast Cancer Risk. *Current Environmental Health Report* 2:1-14 (2015).

Sess 4: Feb. 16 **Herbicide Tolerant Crops**

Strategy behind herbicide tolerance; how framers benefit; consumer benefits; no-till vs tillage farming; Ready Roundup seeds and Glyphosate; toxicology of Glyphosate; IARC report as a probable human carcinogen; critics of IARC.

Readings

Krimsky/Wrubel, Ch. 2 Herbicide Resistant Crops

Fedeeroff/Brown, Ch. 2 The Wild and the Sown, pp. 23-45. Ch. 3, The Power of the Earth, pp. 47-66.

Sess 5: Feb. 23 **Insect Resistant Crops**

Theory behind natural and artificial insecticidal plants; lectins; Bacillus thuriengensis (Bt) as an insecticide; Bt crops—benefits and risks; Bt resistant insects; residue of Bt toxins in the human body; reduction of chemical pesticides.

Readings

Krimsky/Wrubel Ch. 3 Insect Resistant Plants

Federoff/Brown, Ch. 4 Genes & Species, pp. 67-83.

Updated article on insect resistance in transgenic crops and their use in agriculture.

Sess 6: Mar. 1 **Disease Resistant Crop and Nitrogen Fixation**

On the process of "vaccinating" plants against disease. Benefits of genetically modifying pplants for disease resistance; efforts to build in nitrogen fixation on plants; reduced nitrogen load in agriculture.

Readings:

Krimsky/Wrubel Ch. 4 Disease Resistant Crops

David B. Collinge & Ole Søgaard Lund & Hans Thordal-Christensen. What are the prospects for genetically engineered, disease resistant plants? *Eur J Plant Pathol* (2008) 121:217–231

Current applications and progress in transgenic crops that are disease resistant.

Sess. 7: Mar. 8 **Patenting Seeds and Patents on Life**

Supreme Court Chakrabarty decision on patenting a microbe; patents on seeds; controversy over seed patents; countries that oppose patents on seeds;

Readings

Philip Howard, Intellectual Property and Consolidation in the Seed Industry, *Crop Science* 55:1-7 (Nov.-Dec. 2015).

Sess. 8 Mar. 16 **Transgenic Animals**

New breeds of farm animals; animals producing drugs; cloning animals; reversing extinction;environmentally resilient species; transgenic salmon; animals bred for human organs.

Readings

Spring Break: Mar. 19-28

Sess. 9 Mar. 29 **Glyphosate/ Ready Roundup**

Expanded use of glyphosate with GMO Ready Roundup soybeans; history of glyphosate; industry profile; regulatory profile; IARC study & criticism.

Readings

EPA Fact Sheet on Glyphosate

IARC Report on Glyphosate. July 2015

Monsanto Fact Sheet on Glyphosate. 2010 Monsanto Technology LLC. Roundup Promax® Herbicide Technical Fact Sheet

Sess. 10 Apr. 5 **Regulatory Policy on GMOs**

Biotechnology US regulatory framework; EPA, FDA; USDA; organic standard; 1992 FDA policy and critics.

Readings

Federoff/Brown, Ch. 7, The Product or Process, pp. 129-154,

Rebecca C. Harris, State Responses to Biotechnology: Legislative action and policymaking in the U.S., 1990-2010 *Politics and the Life Sciences* 34(1): Spring 2015.

Mark Lynas With G.M.O. Policies, Europe Turns Against Science *New York Times* October 24, 2015. SundayReview | Opinion

Directive (EU) 2015/412 of the European Parliament and of the Council March 11, 2015

Additional Source

David Demortain, Regulatory Toxicology in Controversy, *Science Technology Human Values* published online 27 May 2013

Sess. 11: Apr. 12 **Labeling GMO Food**

State and federal initiatives on labeling;Vermont's labeling law; litigation; federal preemption bill; Mass labeling bill.

Readings

Sess. 12: Apr. 19 **GMO Health Assessment**

Are GMOs safe for consumers; animal feeding tests; evidence of risk; Pusztai affair; Seralini study;

Readings

S. Krimsky, An illusory consensus behind GMO health assessment, STHV

Arun Kumar, Sathish Kumar, Gayatri and Nishanth, A Comprehensive Assessment and Perception of Genetically Modified Foods. *J Genetic Syndromes and Gene Therapy* 2:3 (2011)

Judy A. Carman, Howard R. Vlieger, Larry J. Ver Steeg, Verlyn E. Sneller, Garth W. Robinson, Catherine A. Clinch-Jones1, Julie I. Haynes, John W. Edwards. (2013) A long-term toxicology study on pigs fed a combined genetically modified (GM) soy and GM maize diet. ISSN 1177-4258, pp.38-54.

Federoff/Brown, Ch. 8, Is it Safe to East, pp. 155-175; Ch. 9, Poisoned Rats or Poisoned Wells, pp. 177-199.

Arpad Pusztai and Susan Bardocz. (2011). Potential Health Effects of Foods Derived from Genetically Modified Plants: What Are the Issues? Norsk institutt for genøkologi (GenØk), Tromsø, and Tapir Academic Press, Trondheim, 2011.

Sess. 13: Apr. 26 **Current Trends in GMOs: Golden Rice; GMO Wheat**

Readings

Federoff/Brown, Ch. 1, Against the Ways of Nature, pp. 1-21.

Bruce Alberts , Roger Beachy , David Baulcombe , Gunter Blobel , Swapan Datta , Nina Fedoroff , Donald Kennedy , Gurdev S. Khush , Jim Peacock , Martin Rees , Phillip Sharp, Standing Up for GMOs, *Science* 341: 1320 (September 30, 2013).

Claire Marris, Public views on GMOs: deconstructing the myths, 2001 European Molecular Biology Organization EMBO reports vol. 2 | no. 7 | 2001 545.

Michael Hansen, Genetic Engineering is not an Extension of Conventional Plant Breeding. Consumer Policy Institute, Consumer Union.

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