UNIVERSITY OF HOHENHEIM

Ethics of Science

3502-440 Methods of Scientific Working for Crop Science

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Letters to Nature

Genetic diversity and disease control in rice

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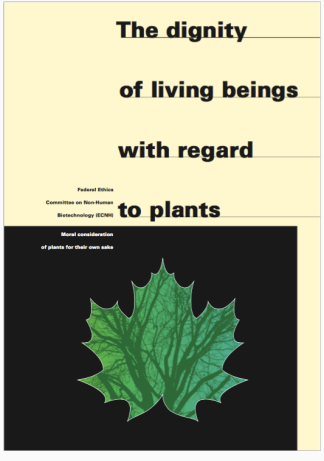
Crop heterogeneity is a possible solution to the vulnerability of monocultured crops to disease[1–3]. Both theory[4] and observation[2,3] indicate that genetic heterogeneity provides greater disease suppression when used over large areas, though experimental data are lacking. Here we report a unique cooperation among farmers, researchers and extension personnel in Yunnan Province, China—genetically diversified rice crops were planted in all the rice fields in five townships in 1998 and ten townships in 1999. Control plots of monocultured crops allowed us to calculate the effect of diversity on the severity of rice blast, the major disease of rice[5]. Disease-susceptible rice varieties planted in mixtures with resistant varieties had 89% greater yield and blast was 94% less severe than when they were grown in monoculture. The experiment was so successful that fungicidal sprays were no longer applied by the end of the two-year programme. Our results support the view that intraspecific crop diversification provides an ecological approach to disease control that can be highly effective over a large area and contribute to the sustainability of crop production.



What is ethics?

- Ethics is dealing with questions about which forms of human conduct are morally good or bad
- As a science, it's part of philosophy
- Ethical questions appear in all aspects of life

Where to find answers?

A philosophical joke:

> *But how did the people in the scripture know the signals they were getting were really from God? Abraham thought he was called by God to sacrifice his son on the altar. Abraham figures, "If God says so, I'd better do it." Our first philosophical query to Abraham is, "What are you, nuts? You hear 'god' tell you to do a crazy thing, and you don't even ask for identification?"*

- Cathcart: Platon walks into a bar

Where to find answers?

- External: Moral authorities, God
- Internal: We ourselves
- Immanuel Kant

  - Liberate ourselves from the self-inflicted nonage
  - Categorical imperative: *Act only according to that maxim whereby you can at the same time will that it should become a universal law without contradiction.*

- Golden Rule:
  Do unto others as you would have others do unto you.
- Utilitarianism: Good behaviour is the behaviour that gives maximal positive effects (*For the greater good*)

Are there objective answers to ethical questions?

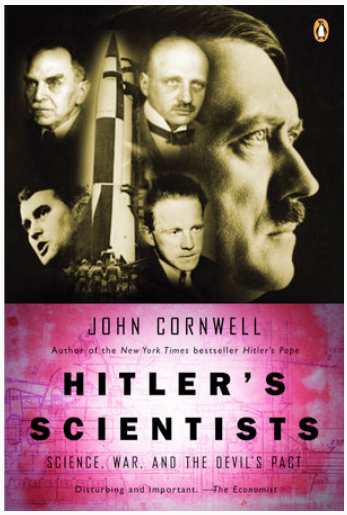
- Moral relativism: Studying different ethical systems
- Ethnocentralism: Societies judge ethical problems from their view
- Ethics in context of neurobiology & evolution

Universal moral principles and guidelines

- **Nonmalificence:** Do not harm yourself or other people
- **Beneficence:** Help yourself and other people
- **Autonomy:** Allow rational individuals to make free, informed choices
- **Justice:** Treat people fairly; treat equals equally, unequals, unequally.
- **Utility:** Maximize the ratio of benefits to harms for all the people.
- **Fidelity:** Keep your promises and agreements
- **Honesty:** Do not lie, defraud, deceive, or mislead
- **Privacy:** Respect personal privacy and confidentiality

Why an ethics of science is important

Sigmund Rascher (1909-1945) worked as Doktor and Scientist in the Dachau Concentration Camp



Ethics of science

Three domains of ethics in science:

- Ethics of the scientist
- Ethics of scientific experiments
- Ethics of scientific results

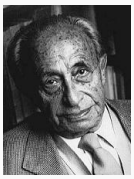
Ethics of the scientist

- Good Scientific Practice

Ethics of scientific research

- “Nazi doctors” such as Sigmund Rascher (1909-1945)
- Large-scale experiments to dampen rice blast epidemics in china
- Foodwatch: Experiments in children with golden rice
- Milgram experiment/Stanford prison experiment in psychology
- Cloning experiments, gene editing in humans

Different sciences have different ethical issues



Hans Jonas (1903-1993)

Ethics of scientific results

- Open access or behind paywalls? Who ”owns” scientific results? Corporate results?
- Make big claims of your scientific results?
- Data availability: Should you be obliged to publish all data? (see `http://www.nature.com/scientificdata/for-authors/data-deposition-policies/`)
- Are scientists responsible for how their results are used? Example: Genetic manipulation of the influenza virus H5N1, see `http://www.sciencemag.org/content/336/6088/1521`

Further reading

- Zwart (2009) - Application of ethics in the field of plant biotechnology

References i

Zwart, H. (2009). Biotechnology and naturalness in the genomics era: plotting a timetable for the biotechnology debate. *Journal of Agricultural and Environmental Ethics*, 22(6):505–529.