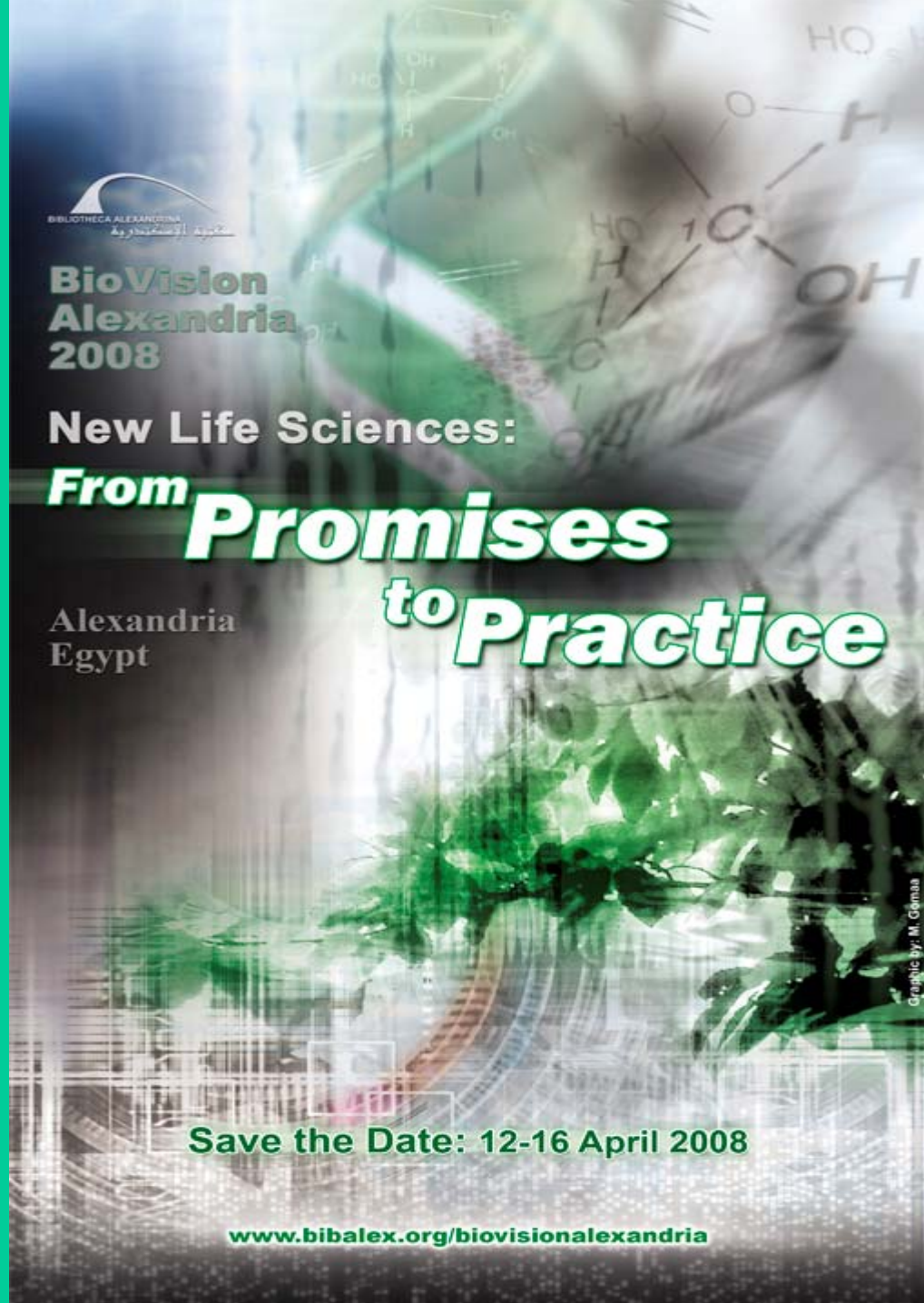
Panel C-5: Food for a Better World

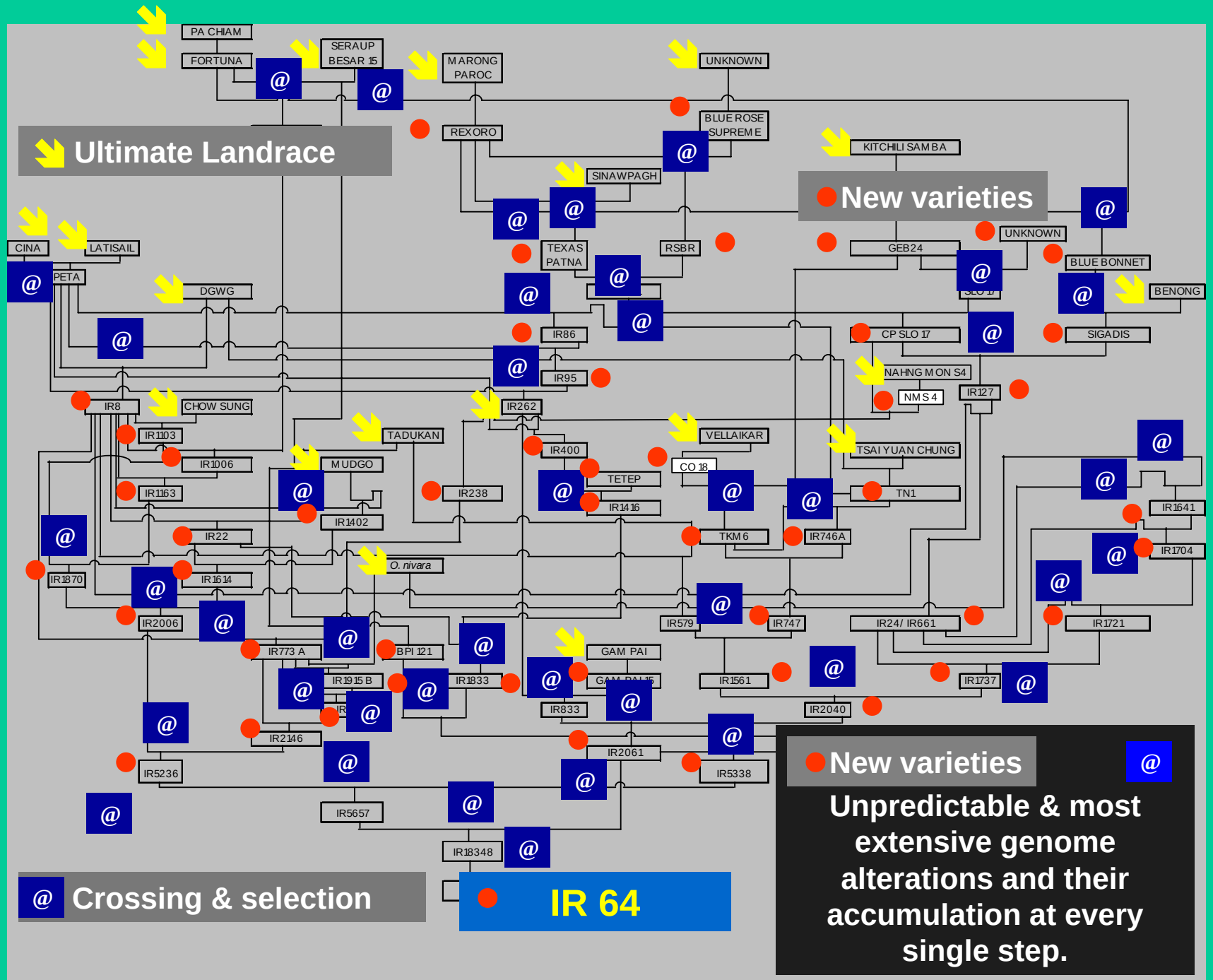
Chair:
Prof. Dr. Klaus Ammann

Delft University of Technology, Netherlands

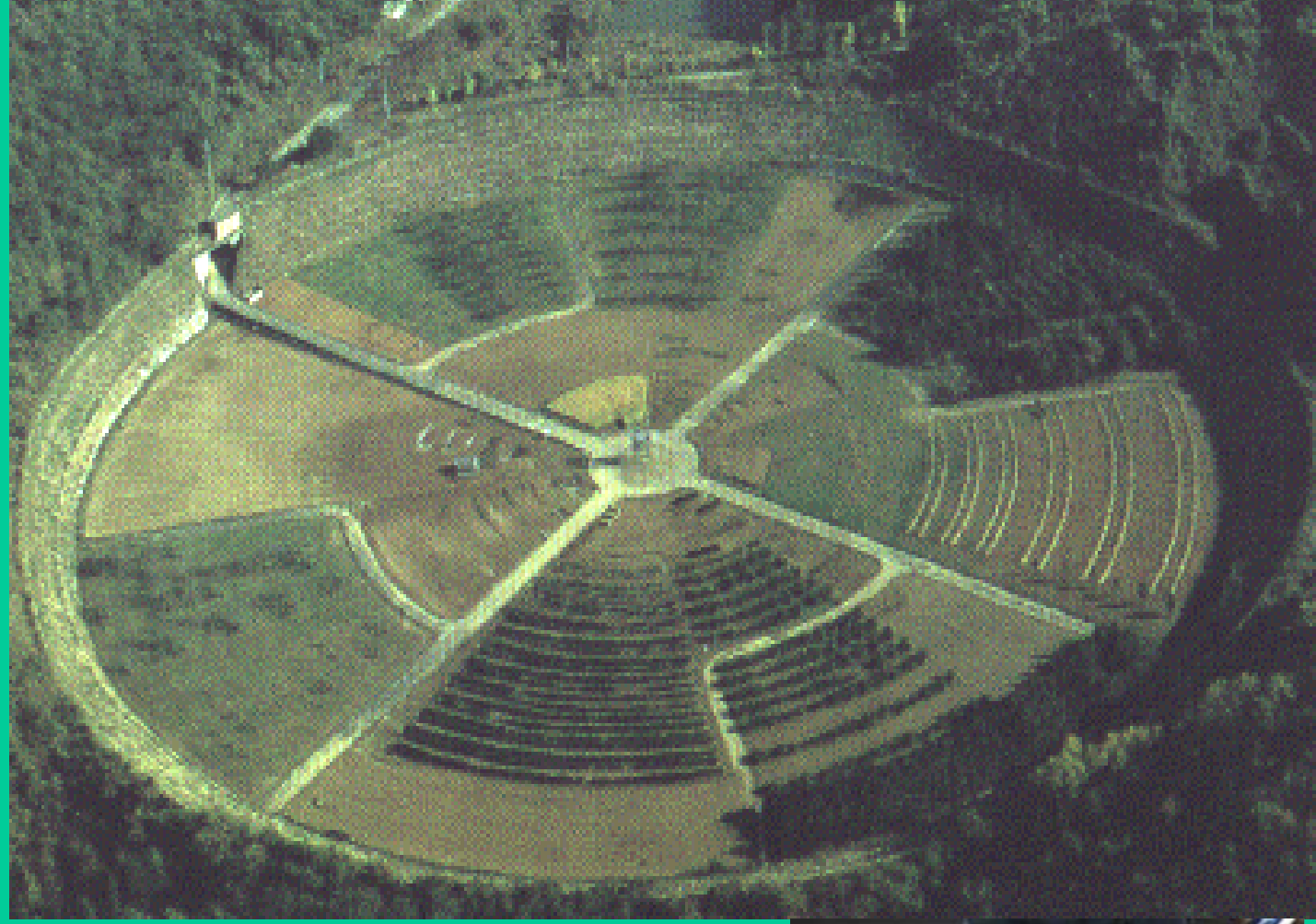
Introductory remarks about
science, the press and NGOs



Breeding tree for *Indica variety* IR64



Gamma Field for radiation breeding



100m radius

89 TBq Co-60 source at the center Shielding dike 8m high

Institute of Radiation Breeding
Ibaraki-ken, JAPAN
http://www.irb.affrc.go.jp/

Better spaghettis, whisky

1800 new plants

Werner Arber, Nobel Laureate 1978:

Interestingly, naturally occurring molecular evolution, i.e. the spontaneous generation of genetic variants has been seen to follow exactly the same three strategies as those used in genetic engineering14. These three strategies are:

(a) small local changes in the nucleotide sequences,
(b) internal reshuffling of genomic DNA segments, and
(c) acquisition of usually rather small segments of DNA from another type of organism by horizontal gene transfer.

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828
http://www.botanischergarten.ch/Mutations/Arber-Comparison-2002.pdf

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828
http://www.botanischergarten.ch/Mutations/Arber-Comparison-2002.pdf

However, there is a principal difference between the procedures of genetic engineering and those serving in nature for biological evolution. While the genetic engineer pre-reflects his alteration and verifies its results, nature places its genetic variations more randomly and largely independent of an identified goal.

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828
http://www.botanischergarten.ch/Mutations/Arber-Comparison-2002.pdf

Arber, W. (2002)
Roots, strategies and prospects of functional genomics. Current Science, 83, 7, pp 826-828
http://www.botanischergarten.ch/Mutations/Arber-Comparison-2002.pdf

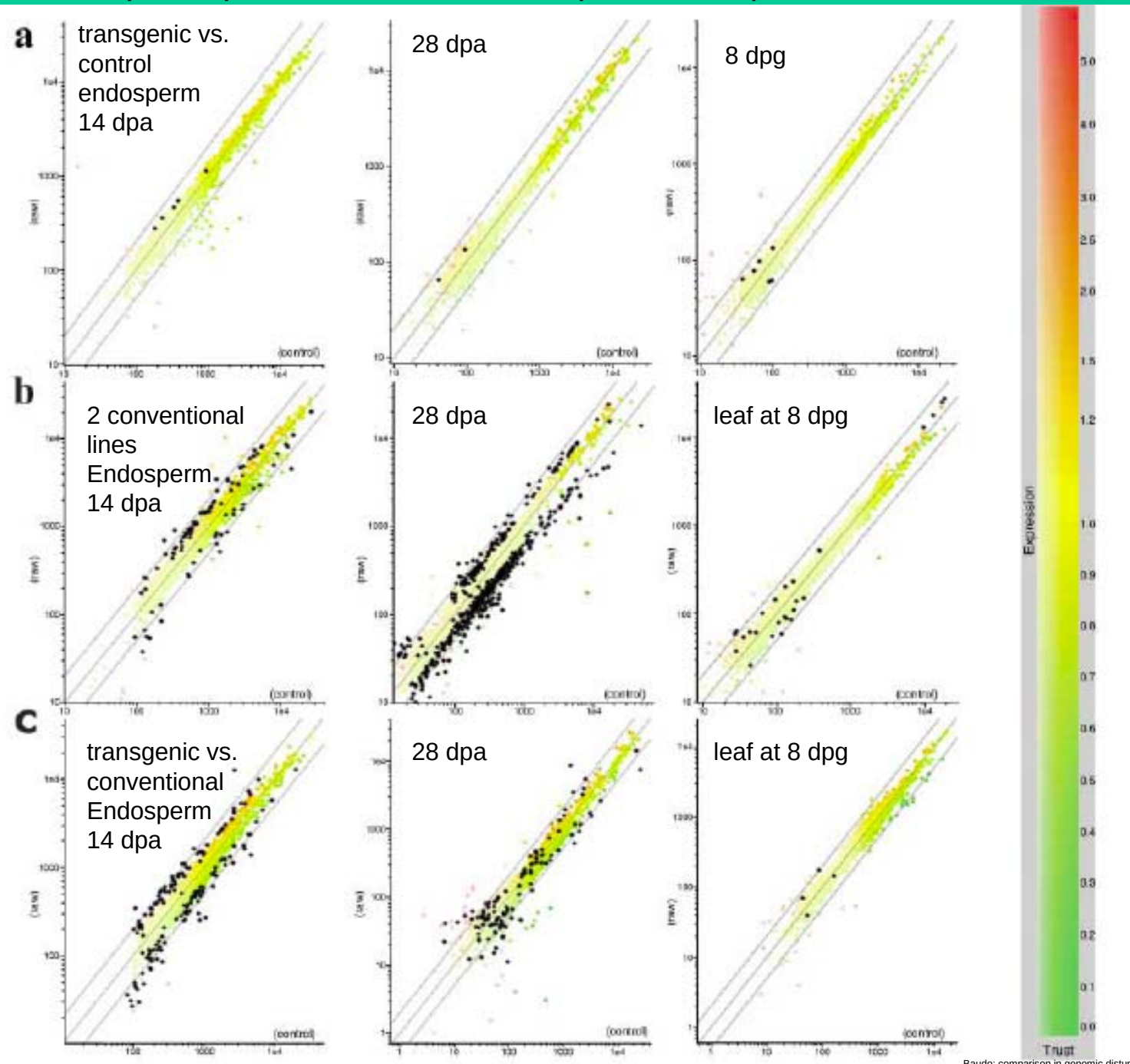
Concepts of Intrinsic Value and Integrity of Plants in Organic Plant Breeding and Propagation

E. T. Lammerts van Bueren,* P. C. Struik, M. Tiemens-Hulscher, and E. Jacobsen

van Bueren, E.T.L., Struik, P.C., Tiemens-Hulscher, M., & Jacobsen, E. (2003)
Concepts of intrinsic value and integrity of plants in organic plant breeding and propagation.
Crop Science, 43, 6, pp 1922-1929
http://www.botanischergarten.ch/Organic/van-Bueren-Organicbreeding.pdf

The natural approach taken by organic agriculture obviates the use of synthetic agrochemicals and emphasizes farming in accordance with agroecological principles. Also implicit in this approach is an appreciation for the *integrity* of living farm organisms, with the integrity being evaluated from a biocentric perspective. The ethical value assigned to integrity of organisms has challenged us to develop criteria for evaluating both integrity and breeding techniques. For cultivated plants, integrity refers to their inherent nature, their wholeness, completeness, species-specific characteristics, and their being in balance with their (organically farmed) environment. We evaluate integrity using criteria derived from four different perspectives: integrity of life, plant-specific integrity, genotypic integrity, and phenotypic integrity.

Scatter plot representation of transcriptome comparisons, Baudo et al. 2006



Baudo: comparison in genomic disturbance: GM crops are less disturbed (black dots) than classic breeds

Baudo, M.M., Lyons, R., Powers, S., Pastori, G.M., Edwards, K.J., Holdsworth, M.J., & Shewry, P.R. (2006)
Transgenesis Has Less Impact on the Transcriptome of Wheat Grain Than Conventional Breeding. Plant Biotechnology Journal, 4, 4, pp 369-380
http://www.botanischergarten.ch/Organic/Baudo-Impact-2006.pdf

Shewry, P.R. & Jones, H.D. (2005)
Transgenic Wheat: Where Do We Stand after the First 12 Years? Annals of Applied Biology, 147, 1, pp 1-14
http://www.botanischergarten.ch/Organic/Shewry-Performance-2006.pdf

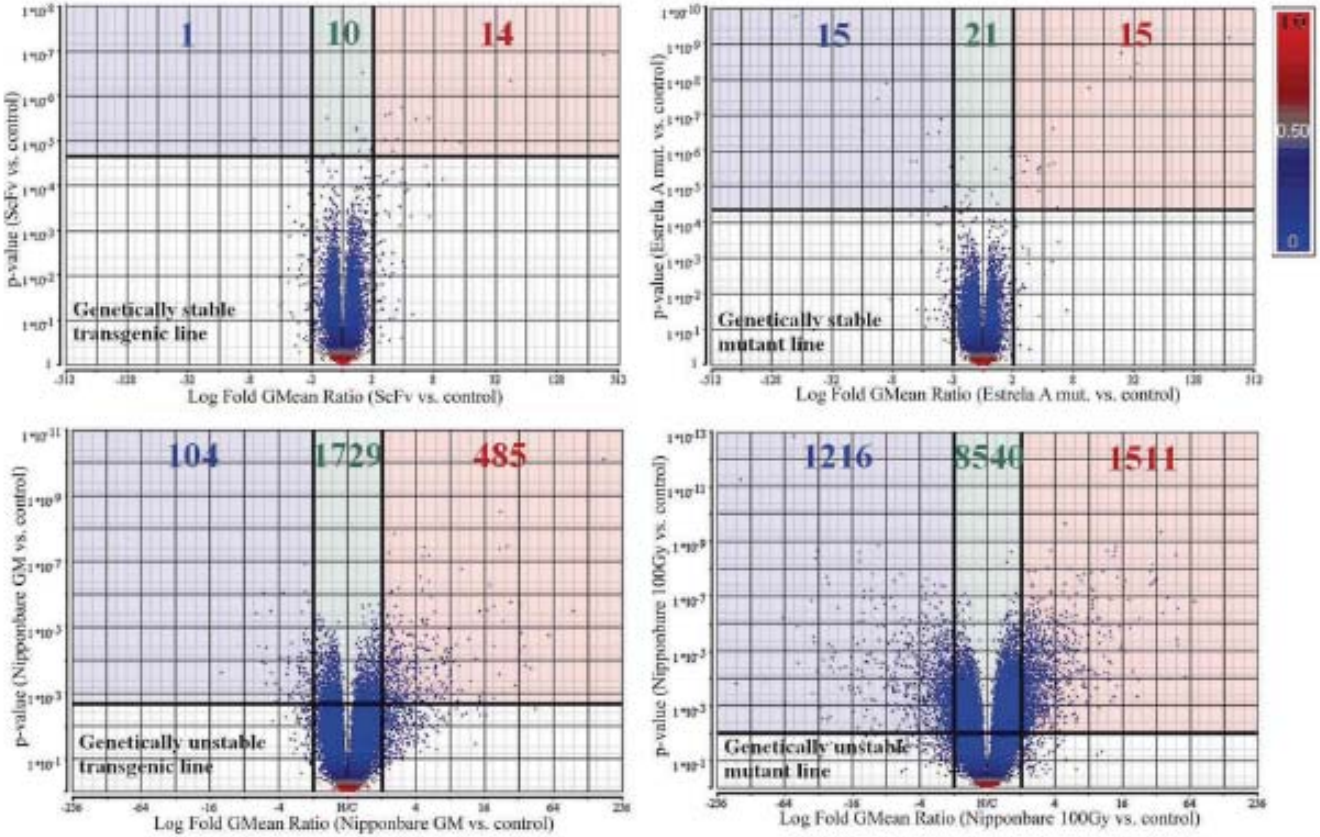


Fig. 2. Volcano plots for differentially expressed genes. Differentially expressed genes appear above the thick horizontal lines. Genes induced >2-fold are on the right of the right vertical lines, and the ones repressed >2-fold are on the left of the left vertical line. The numbers corresponding to the differentially expressed genes induced >2-fold for each experiment (red-shadowed area) are red, and those corresponding to the genes repressed >2-fold (blue-shadowed area) are blue. The green-shadowed area corresponds to differentially expressed genes that were up- or down-regulated <2-fold (green-colored numbers). Blue-colored genes are those with *P* between 0 and 0.5, and red-colored genes are those with *P* between 0.5 and 1.

Batista, R., Saibo, N., Lourenco, T., & Oliveira, M.M. (2008)
Microarray analyses reveal that plant mutagenesis may induce more transcriptomic changes than transgene insertion. Proceedings of the National Academy of Sciences of the United States of America, 105, 9, pp 3640-3645
http://www.botanischergarten.ch/Genomics/Batista-Microarray-Analysis-2008.pdf

Plant Biotechnology Journal (2006) **4**, pp. 369–380 doi: 10.1111/j.1467-7652.2006.00193.x

Transgenesis has less impact on the transcriptome of wheat grain than conventional breeding

María Marcela Baudo[1], Rebecca Lyons[1], Stephen Powers[1], Gabriela M. Pastori[1,†], Keith J. Edwards[2], Michael J. Holdsworth[3] and Peter R. Shewry[1,*]

[1]*Rothamsted Research, Harpenden AL5 2JQ, UK*

[2]*School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS8 1UG, UK*

[3]*Division of Agricultural and Environmental Sciences, School of Biosciences, University of Nottingham, Nottingham NG7 2RD, UK*

Differences observed in gene expression in the endosperm between conventionally bred material were much larger in comparison to differences between transgenic and untransformed lines exhibiting the same complements of gluten subunits. These results suggest that the presence of the transgenes did not significantly alter gene expression and that, at this level of investigation, transgenic plants could be considered substantially equivalent to untransformed parental lines.

Reconciling Traditional Knowledge with Modern Agriculture: A Guide for Building Bridges

KLAUS AMMANN, *Guest Professor, Delft University of Technology, Department of Biotechnology, The Netherlands*

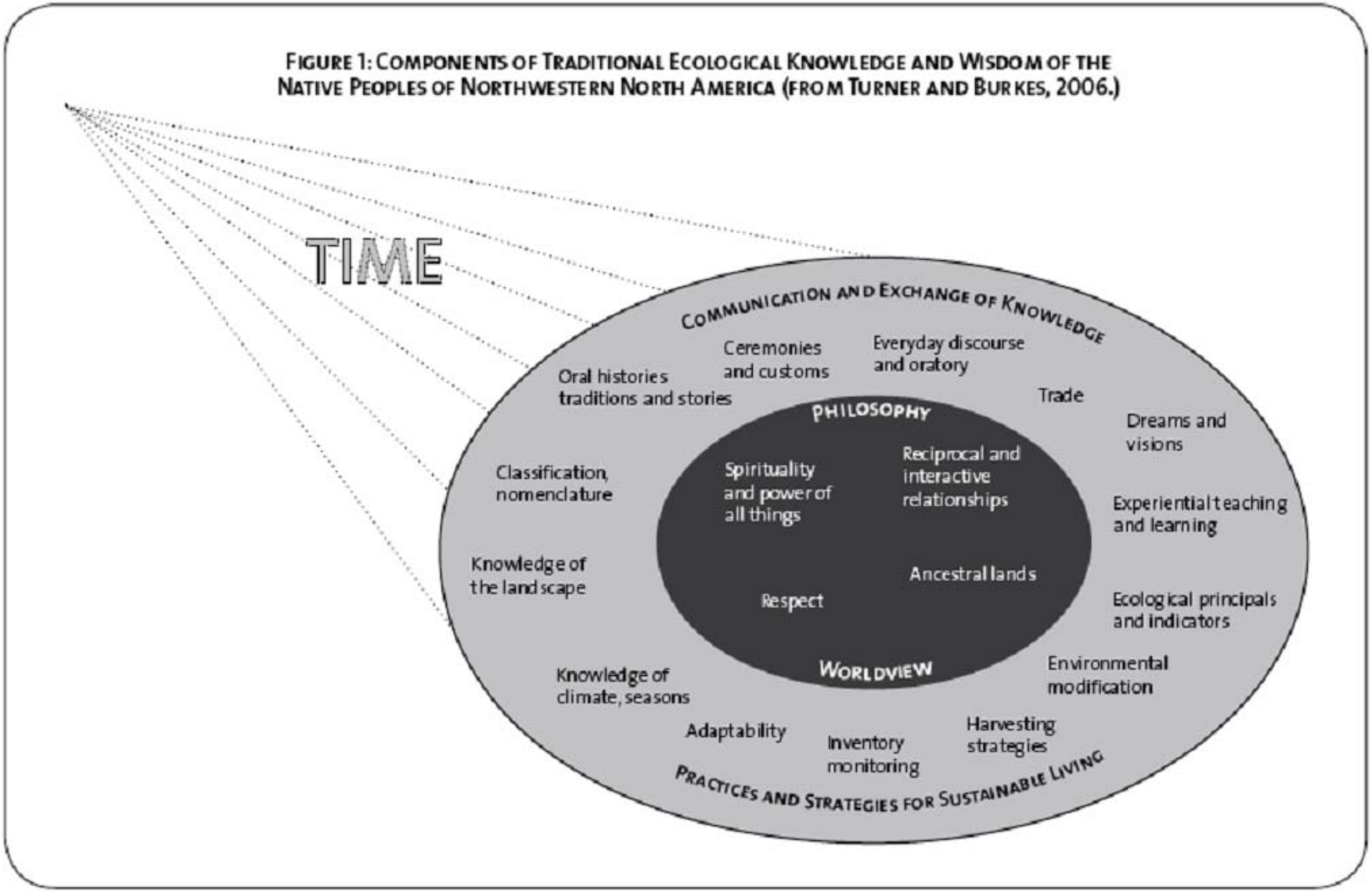
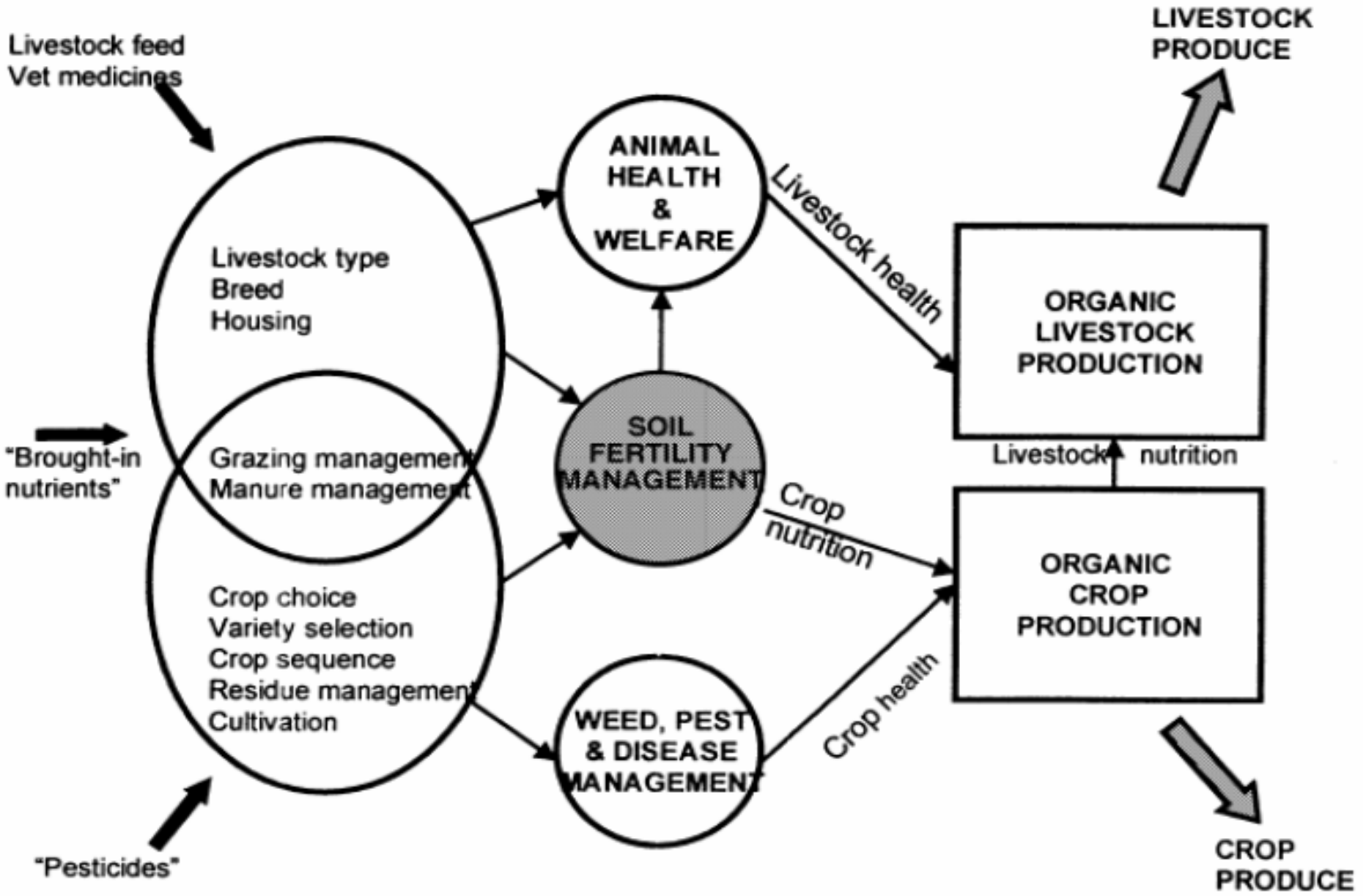


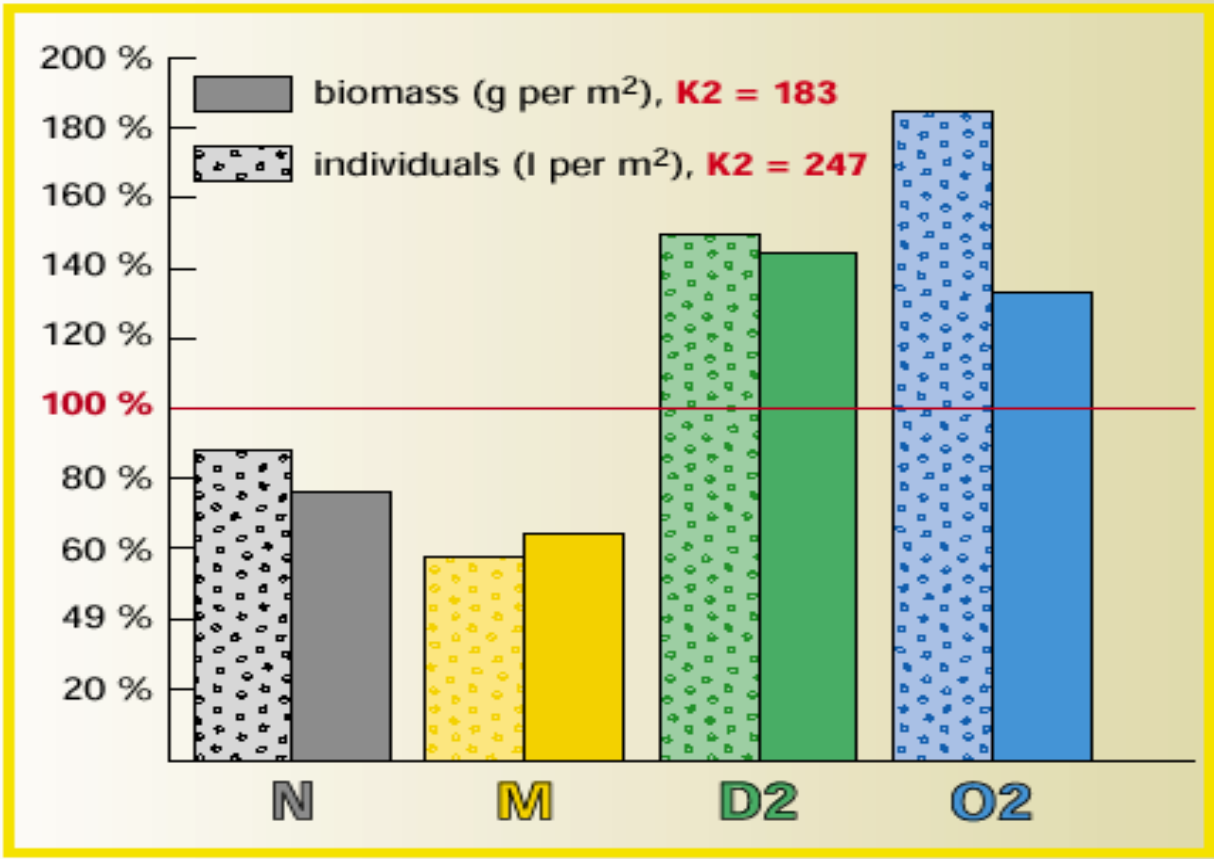
FIGURE 1: COMPONENTS OF TRADITIONAL ECOLOGICAL KNOWLEDGE AND WISDOM OF THE NATIVE PEOPLES OF NORTHWESTERN NORTH AMERICA (FROM TURNER AND BURKES, 2006.)

Ammann, K. (2007)
Reconciling Traditional Knowledge with Modern Agriculture: A Guide for Building Bridges. *In Intellectual Property Management in Health and Agricultural Innovation a Handbook of Best Practices, Chapter 16.7* (eds A. Krattiger, R.T.L. Mahoney, L. Nelsen, G.A. Thompson, A.B. Bennett, K. Satyanarayana, G.D. Graff, C. Fernandez & S.P. Kowalsky), pp. 1539-1559. MIHR, PIPRA, Oxford, U.K. and Davis, USA chapter 16.7 http://www.botanischergarten.ch/TraditionalKnowledge/Ammann-Traditional-Biotech-2007.pdf free of copyrights



Watson, C.A., Atkinson, D., Gosling, P., Jackson, L.R., & Rayns, F.W. (2002)
Managing Soil Fertility in Organic Farming Systems. Soil Use and Management, 18, s1 %R doi:10.1111/j.1475-2743.2002.tb00265.x, pp 239-247 http://www.blackwell-synergy.com/doi/abs/10.1111/j.1475-2743.2002.tb00265.x AND http://www.botanischergarten.ch/Organic/Watson-Soil-2002.pdf

Biomass and density of earthworms (average of 1990, 1991 and 1992), K2 = 100 %



The biomass of earthworms in the organic systems was 30–40 percent higher than in the conventional systems, their density even 50–80 percent higher. Compared to the mineral fertilizer system this difference was even more pronounced.

Fliessbach, A., Mader, P., Dubois, D., Gunst, L., Stauffer, W., Fried, P., Pfiffner, L., Alföldi, T., & Niggli, U. (2000)
Organic Farming Enhances Soil Fertility and Biodiversity, Research Institute of Organic Agriculture, Federal Research Station for Agroecology and Agriculture pp 16 Fibl Dossier 1, Frick, Switzerland (Report)
http://www.botanischergarten.ch/Organic/DOC_slim.pdf AND http://www.botanischergarten.ch/Organic/DOC-slim-Slides.ppt

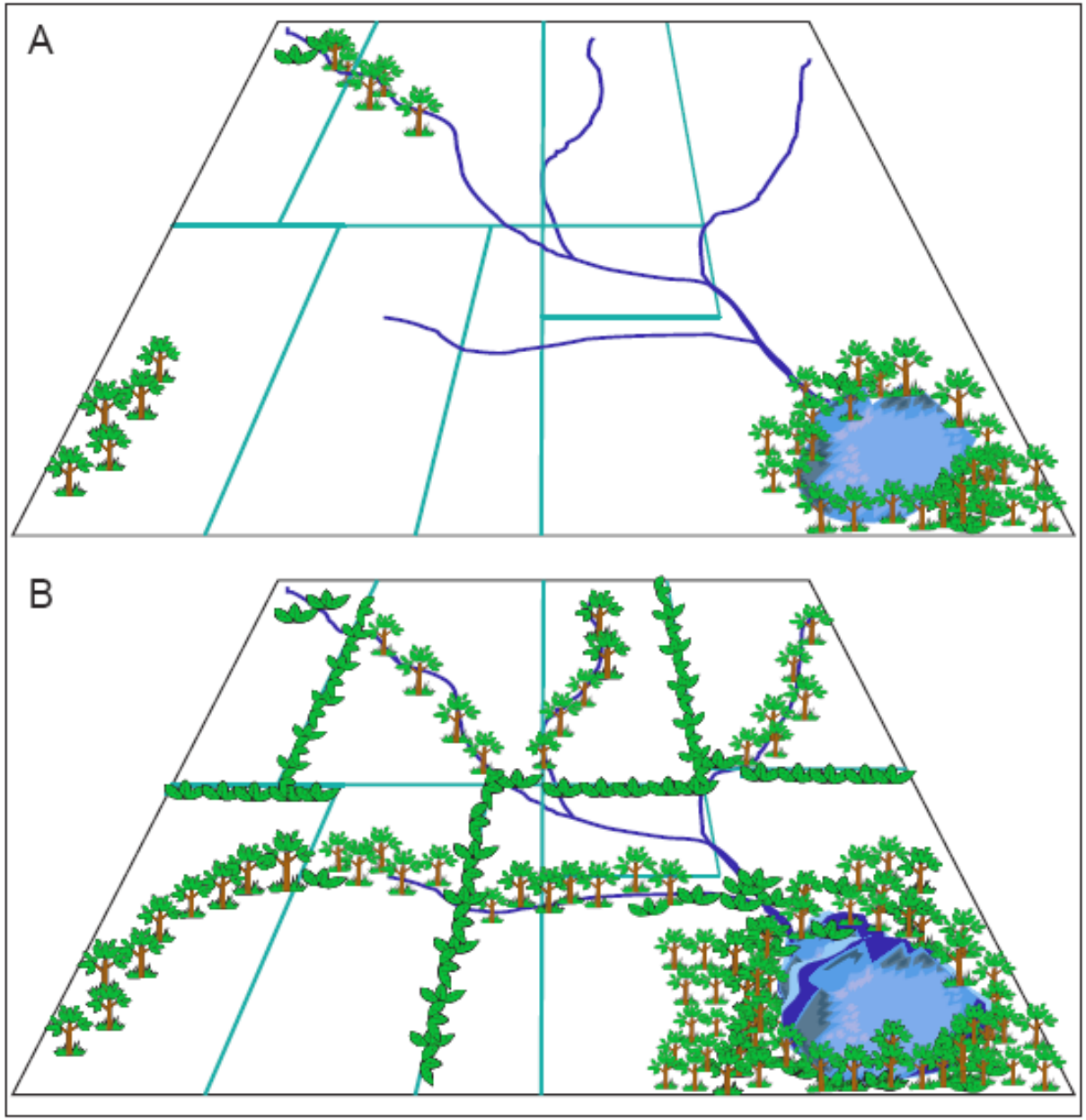


Fig. 6: Enhancing on-farm biodiversity through Integrated Crop Management (adapted from Lefroy et al.,1992). A: The situation before application of ICM methods, showing drainage, fields and non-agricultural vegetation. B: A long-term revegetation plan. Reinstated hedges are used as conservation corridors, windbreaks and field boundaries. Existing remnants have been connected through vegetation corridors.

Dollaker, A. (2006)
Conserving Biodiversity Alongside Agricultural Profitability through Integrated R&D Approaches and Responsible Use of Crop Protection Products. Pflanzenschutz-Nachrichten Bayer, 59, 1, pp 117-134 http://www.botanischergarten.ch/Organic/Dollaker-2006.pdf

Dollaker, A. & Rhodes, C. (2007)
Integrating Crop Productivity and Biodiversity Conservation Pilot Initiatives Developed by Bayer Cropscience, in Weed Science in Time of Transition. Crop Science, 26, 3, pp 408-416 http://www.botanischergarten.ch/Organic/Dollaker-2007.pdf

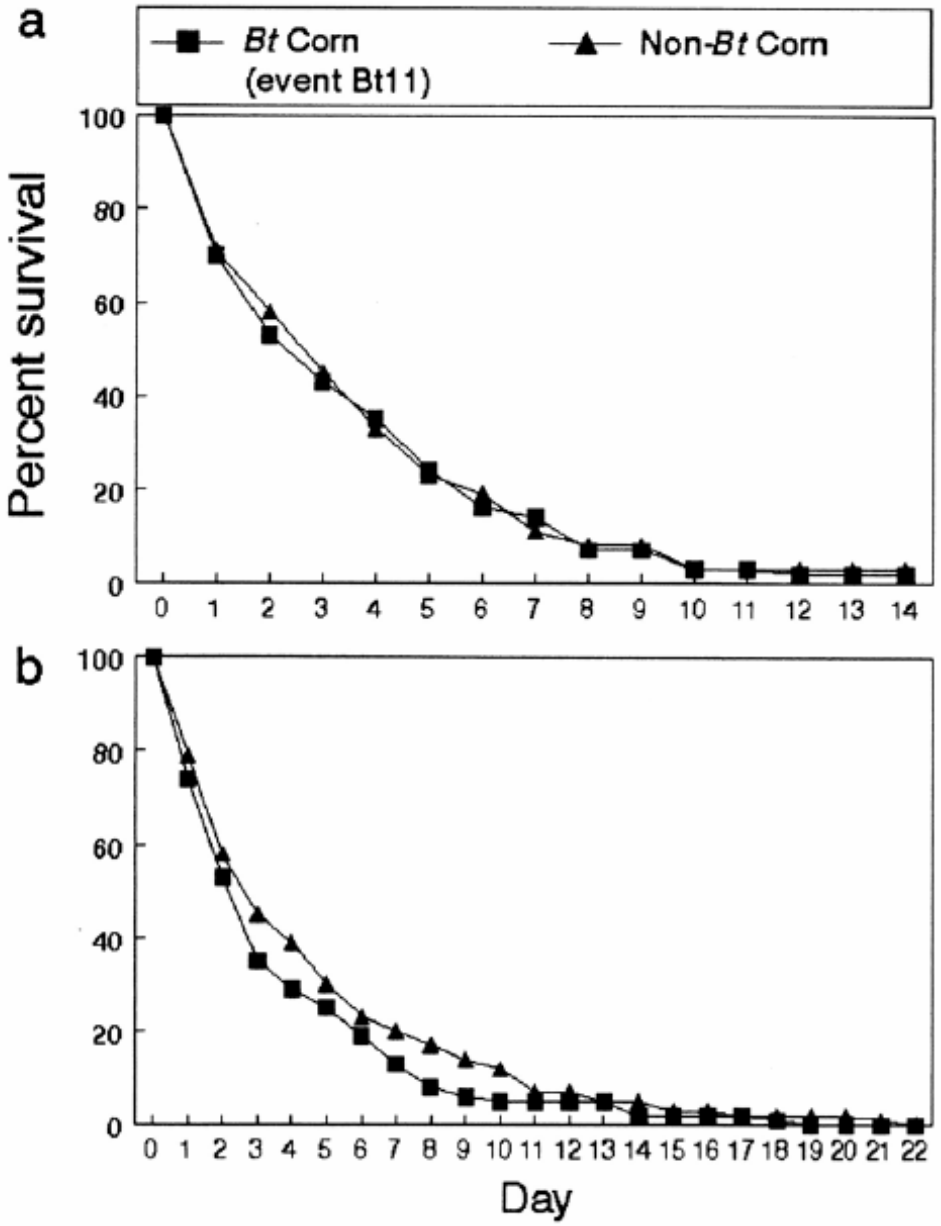


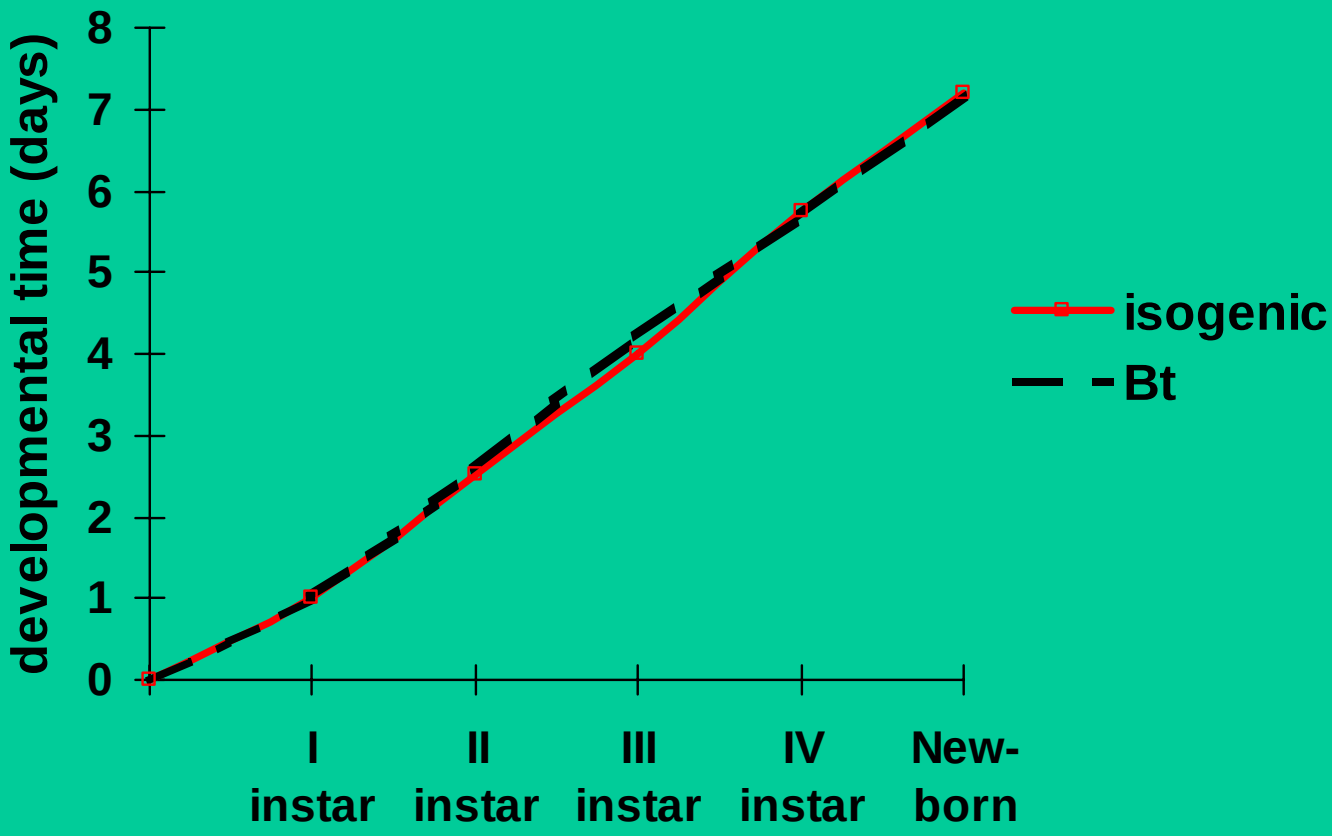
Figure 26: Survival curves for monarch larvae placed in and near *Bt* and non-*Bt* corn fields. (*a*) Iowa. (*b*) New York. The survival curves of larvae pooled over the three Bt corn sites were not significantly different from those in non-Bt (Fig. 13a). In New York, trends in survivorship were also statistically the same for cohorts of larvae feeding for 22 days on milkweeds in Bt and non-Bt fields (Fig. 13b). (Stanley-Horn et al., 2001)

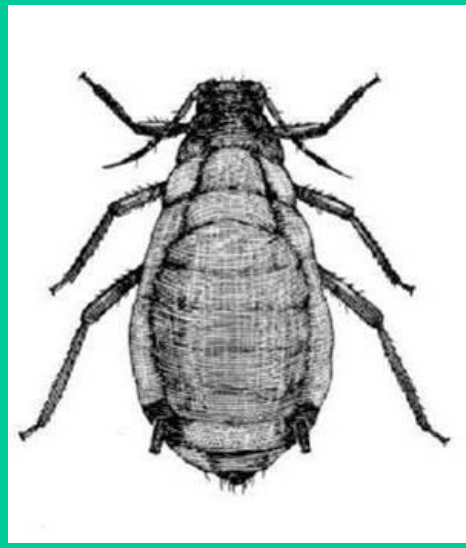
Keeping non-target Insects alive

Sears, M.K., Hellmich, R.L., Stanley-Horn, D.E., Oberhauser, K.S., Pleasants, J.M., Mattila, H.R., Siegfried, B.D., & Dively, G.P. (2001)
Impact of Bt corn pollen on monarch butterfly populations: A risk assessment. Proceedings of the National Academy of Sciences of the United States of America, 98, 21, pp 11937-11942
http://www.botanischergarten.ch/Bt/Searsreport-prelim-2000.pdf

Stanley-Horn, D.E., Dively, G.P., Hellmich, R.L., Mattila, H.R., Sears, M.K., Rose, R., Jesse, L.C.H., Losey, J.E., Obrycki, J.J., & Lewis, L. (2001)
Assessing the impact of Cry1Ab-expressing corn pollen on monarch butterfly larvae in field studies. Proceedings of the National Academy of Sciences of the United States of America, 98, 21, pp 11931-11936
http://www.pnas.org/cgi/content/full/98/21/11931

Averages of two years (1997-1998) of development times (days) of a specific stage for *Rhopalosiphum padi* feeding on transgenic and isogenic corn leaves





Rhopalosiphum padi

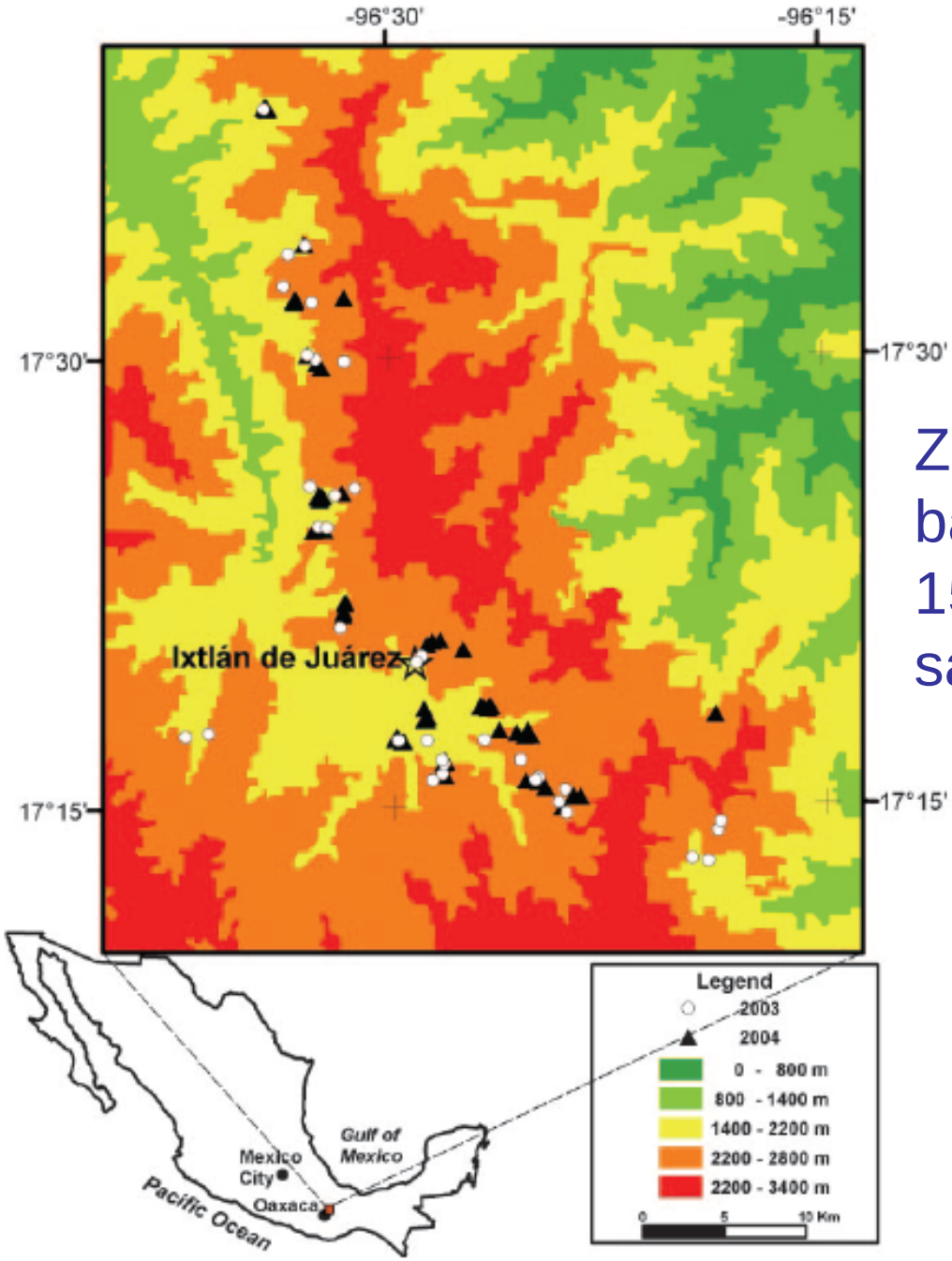
Lozzia, G., Furlanis, C., Manachini, B., & Rigamonti, I. (1999)
Effects of Bt Corn on Rhodopalosiphum Padi (Rhynchota Aphidiae) and on Its Predator Chrysoperla Carnea Stephen (Neuroptera Chrysopidae). Boll. Zool. Agr. Bachic. Ser. II, 30, 2, pp 153-164
http://www.botanischergarten.ch/Bt/Lozzia-Effects-Bt-1998.pdf

Lozzia, G.C. (1999)
Biodiversity and Structure of Ground Beetle Assemblages (Coleopterae, Carabidae) in Bt Corn and Its Effects on Non Target Insects. Boll. Zool. Agr. Bachic. Ser. II, 31, pp 37-58
http://www.botanischergarten.ch/Bt/Lozzia-Biodiversity-1999.pdf

Greenpeace campaign in Mexico 1999,2000

Greenpeace campaign in Mexico, protest without proof of Bt maize gene flow

Cosmogony of Mayas Archeological Museum in Mexico City



Zero result based on 150‘000 samples

Fig. 1. Map of fields in Oaxaca, Mexico, where seeds were collected from maize landraces in 2003 and 2004. Some symbols overlap where fields were close to each other. Global Positioning System coordinates of the localities (villages) in which the fields were located are listed in Table 1.

Ortiz-Garcia, S., Ezcurra, E., Schoel, B., Acevedo, F., Soberon, J., & Snow, A.A. (2005) Absence of detectable transgenes in local landraces of maize in Oaxaca, Mexico (2003-2004). PNAS, 102, 35, pp 12338-12343 http://www.pnas.org/cgi/content/abstract/102/35/12338 and http://www.botanischergarten.ch/Mexico/Ortiz-Snow-PNAS-2005.pdf

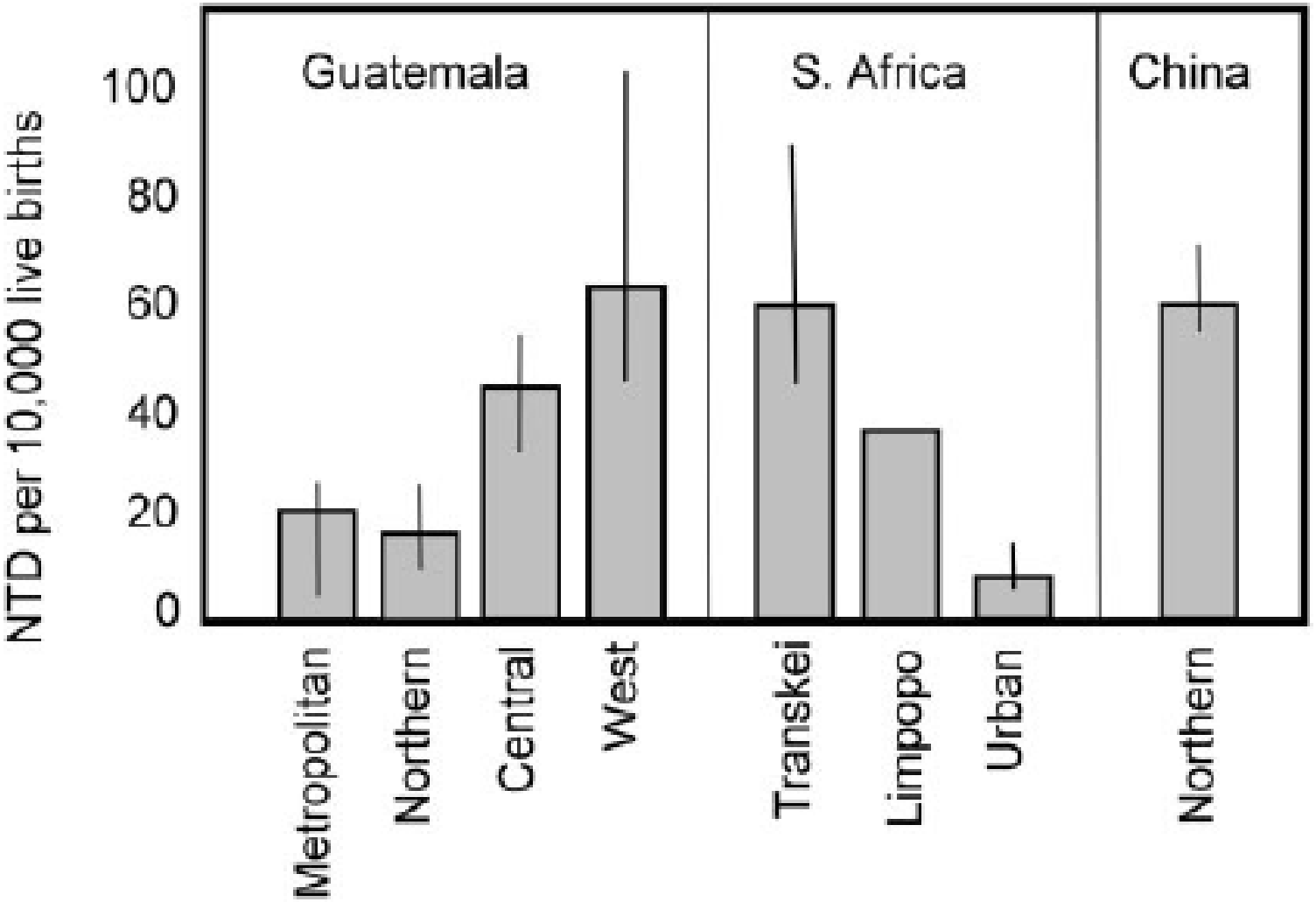
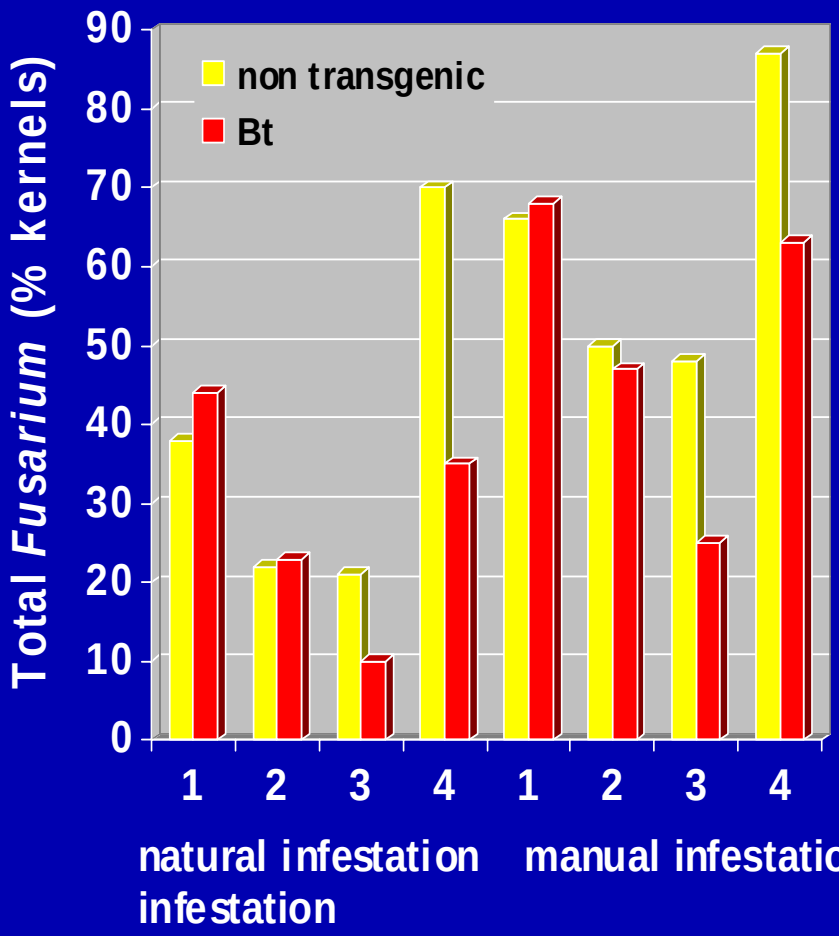


FIGURE 3 Incidence of neural tube defects (NTD per 10,000 live births) in different regions of Guatemala, South Africa, and China. Mean incidence and range in incidence of various locations within the regions or countries are shown; the bar for Limpopo represents one data point. Incidence rates for the United States are similar to those for urban areas in South Africa (41).

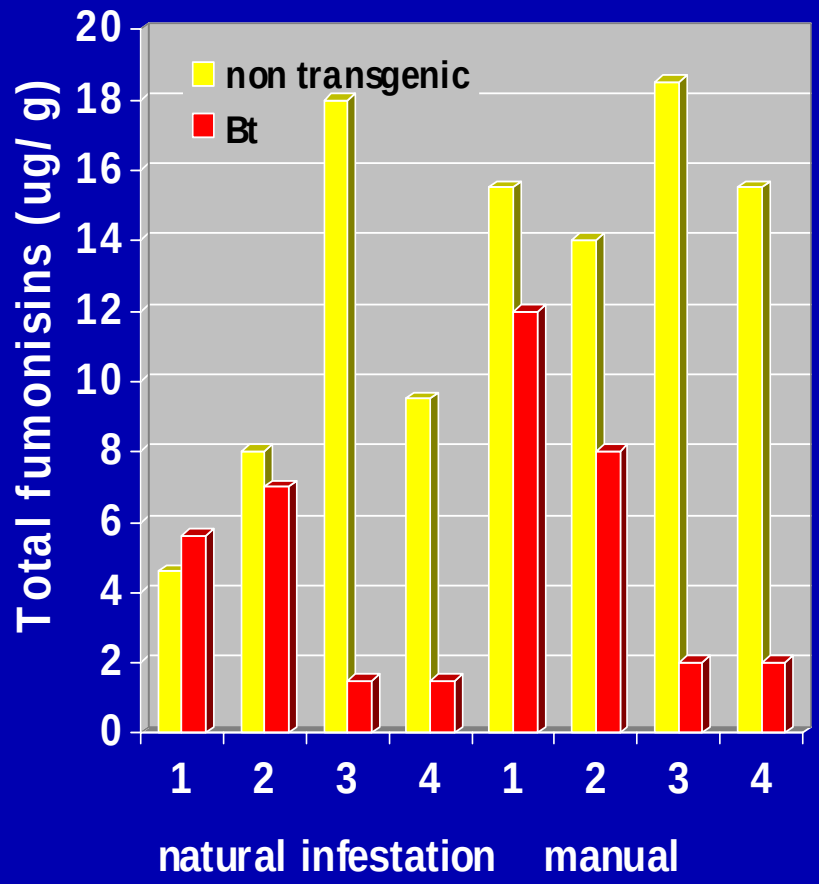
Marasas, W.F.O., Riley, R.T., Hendricks, K.A., Stevens, V.L., Sadler, T.W., Gelineau-van Waes, J., Missmer, S.A., Cabrera, J., Torres, O., Gelderblom, W.C.A., Allegood, J., Martinez, C., Maddox, J., Miller, J.D., Starr, L., Sullards, M.C., Roman, A.V., Voss, K.A., Wang, E., & Merrill, A.H. (2004)
Fumonisins disrupt sphingolipid metabolism, folate transport, and neural tube development in embryo culture and in vivo: A potential risk factor for human neural tube defects among populations consuming fumonisin-contaminated maize. Journal of Nutrition, 134, 4, pp 711-716
http://www.botanischergarten.ch/Bt/Marasas-Fumonisin-Review-2004.pdf

Fusarium infection and mycotoxin content in grain of 4 different Bt-maize, field grown

Fusarium



Fumonisins



After: Munkvold *et al.*, 1997, *Phytopathol.* 87:1071-1077
Munkvold *et al.*, 1999, *Plant Dis.* 83:130-138.

NOVARTIS

EDITORIAL

Another inconvenient truth

In Europe, no one apparently wants to listen if you have good news about genetically modified organisms (GMOs).

Marshall, A. (2007)
Another Inconvenient Truth.In Europe, no one apparently wants to listen if you have good news about genetically modified organisms (GMOs). Nature Biotechnology, 25, 12, pp 1330
http://www.botanischergarten.ch/Bt/Marshall-Inconvenient-Truth-2007.pdf

Results of field release in Italy, left conventional, right transgenic insect-resistant maize
http://www.agbioworld.org Data produced by the University of Milan, Italy

Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione

MINISTERO POLITICHE AGRICOLE E FORESTALI

Results held back for political reasons since March 7, 2006
Data produced by the University of Milan

Ricerche sugli OGM in Agricoltura

RISULTATI

Roma, 7 marzo 2006

Yield

Conventional varieties 11 and 11.1 tons per hectare

Engineered varieties 14.1 and 15.9 tons per hectare.

Increase: 28 to 43 percent.

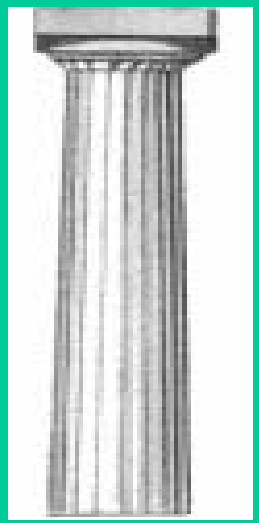
Economic losses 300 million to 1 billion Euro per year due to prohibition of Bt crops

Increase of health risks in conventional maize:

The extensive infection causes a dramatic increase in fumonisin levels, while the engineered varieties had between 100 and 130 times less of the toxins.

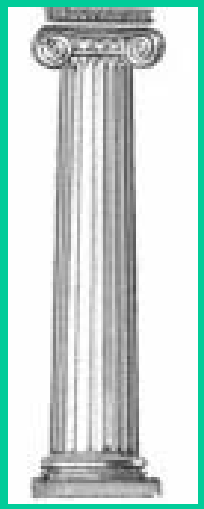
November 13, 2007 - Milan, Italy and Tuskegee, Alabama - via AgBioView, http://www.agbioworld.org ,
Piero Morandini, Milano, piero.morandini@unimi.it
and Roberto Defez, Napoli, defez@igb.cnr.it

Sustainable World



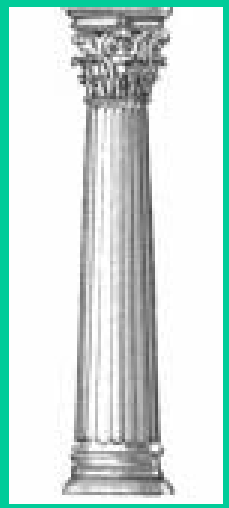
Agriculture

System for renewable natural resources
Knowledge based Agriculture: Organic
Precision Biotechnology



Socio-Economics

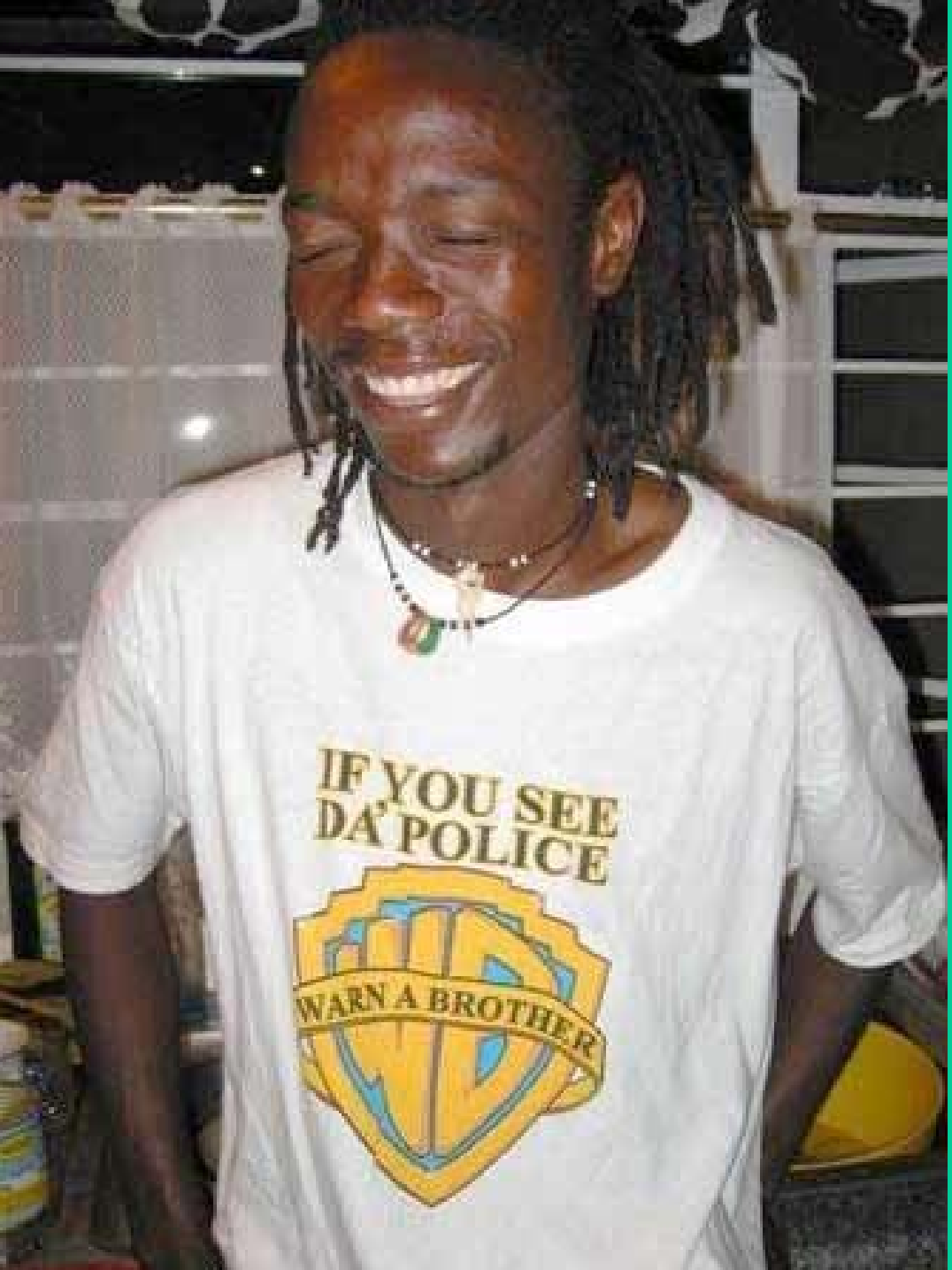
Equity: reconciliation between traditional knowledge and science
global dialogue, reduce agricultural subsidies in developed world



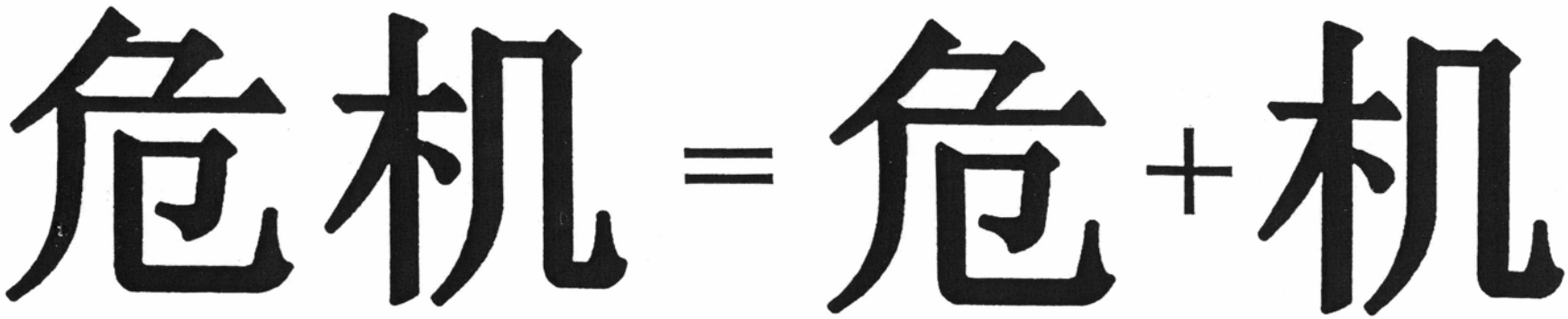
Technologies

Innovation through artificial intelligence influence evolution, new technologies to process food and energy

European Safety Attitude: let not the Europeans decide about Biosafety in Africa, **do your own safety assessment**



another kind of risk attitude

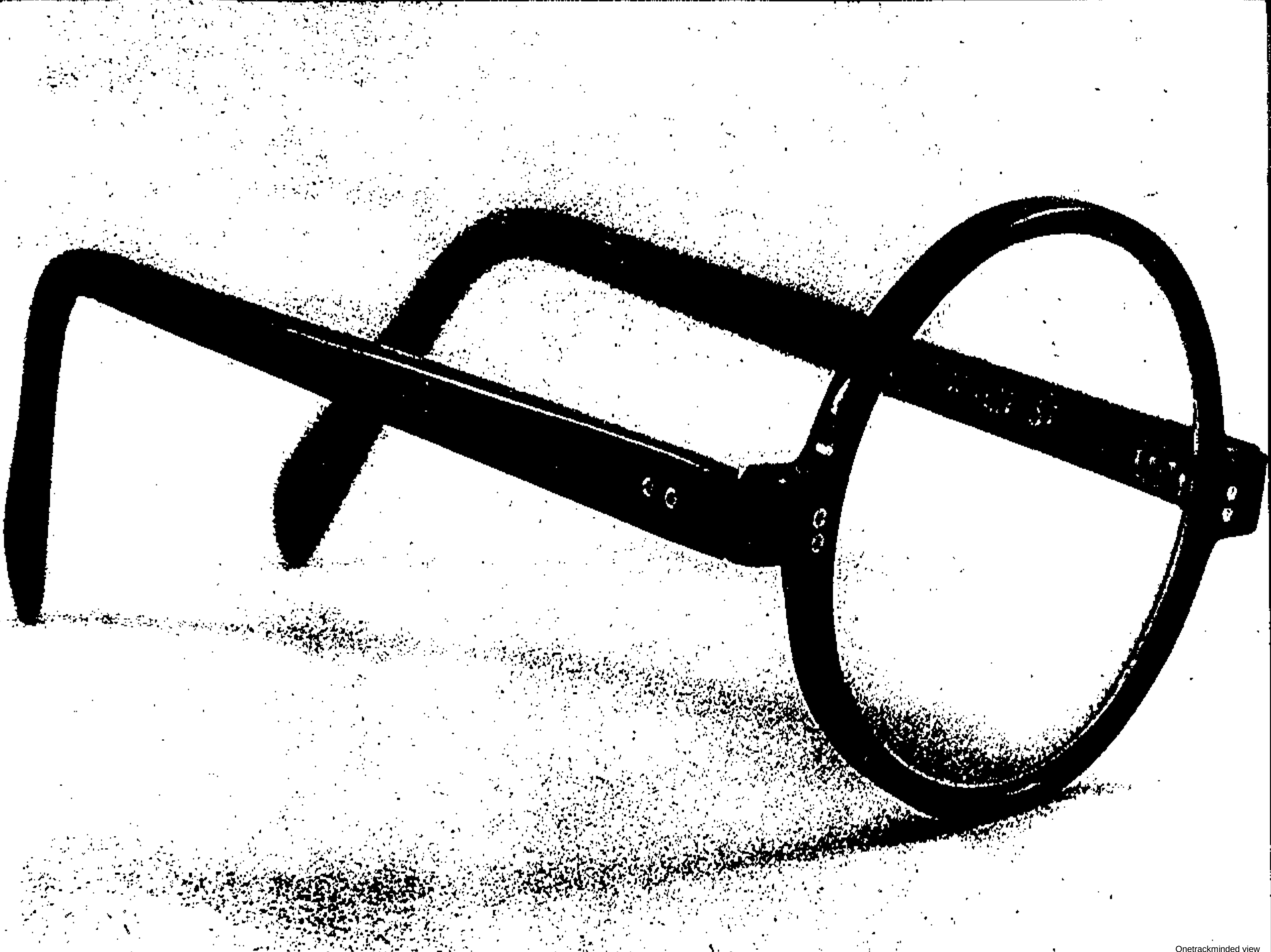


Risk = Hazard / Chance

Widespread definition, but onetrack-minded
Risk = Hazard x Likelyhood
Or worse: Risk = Social bla bla x media frenzy

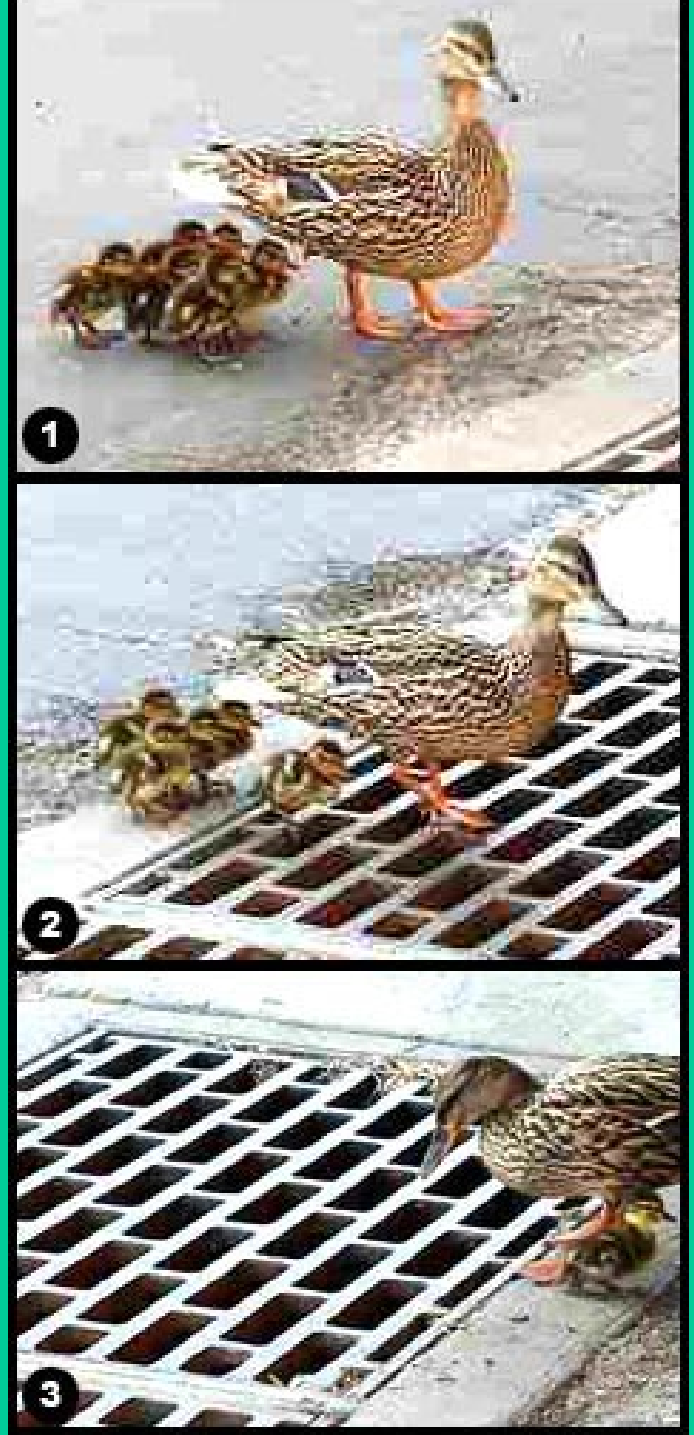
Ammann, K. (2004)
The Role of Science in the Application of the Precautionary Approach,. *In Molecular Farming, Plant-made Pharmaceuticals and Technical Proteins* (eds R. Fischer & S. Schillberg), Vol. 1, pp. 291-302. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim,
http://www.botanischergarten.ch/Precautionary/Ammann-Precautionary-Approach1.pdf

Chinese risk definition



Onetrackminded view


順路
THIS WAY



Misguided Foreign Aid