Biggest challenges and research gaps for organic plant breeding in the Global South

Monika Messmer monika.Messmer@fibl.org

Science Day: Technology Innovation Platform of IFOAM – Organics International (TIPI)
Biofach Messe Nürnberg, 16.2.2018
TIPI: Common Goals to be achieved

• Empower rural areas
• Provide eco-functional intensification that produces food, while harnessing and re-generating eco-system services as well as strengthening resilience to climate change
• Provide food for the health and well-being available to all

• **Plant breeding is key to achieve these goals** but it need to be developed together with improved soil and crop management adjusted to local conditions and demands
• Plant breeding and new technologies like robotics will allow more diverse farming systems optimizing ecosystem services and higher self regulating capacity
• Decentralized participatory breeding approaches strengthens autonomy and self esteem of local farmers
How can Organic Plant Breeding contribute

Ecological intensification of organic production through

• Focused breeding for target environments with limited external inputs
• Selection for specific traits, like seed-borne diseases, weed competition
• Meeting market demand and expectation of farmers and consumer
• Alternative breeding programs refraining from genetic engineering and certain breeding techniques

Enabling more sustainable food production systems through

• Large portfolio of crops on farm level to mitigate risks of crop failure
• Functional biodiversity on field level to reach high level of self regulation and closed nutrient cycle
• Safeguarding and evolving genetic resources for future generations
Strategies for Organic Plant Breeding

Combining breeding & agronomic innovations for Organic

Breeding for increased diversity

- Breeding for diversity within cultivars
- Breeding for mixed cropping systems
- Breeding for improve diversity of associated soil microbes
- Decentralized participatory breeding for local conditions

Embedding diversity into markets

- Involving all stakeholders (farmer, value chain and community driven breeding)
- New concepts for the ownership of cultivars and their financing
- Changing regulatory framework to foster greater agrobiodiversity (official variety testing, seed regulation)
- Valorization of organic plant breeding along the value chain (www.bioverita.org)

www.fibl.org
Breeding for mixed cropping systems to improve resilience of the system towards climate change

Plant – Fauna – Microbe Interaction

Plant – Plant Interaction

Plant – soil microbe Interaction

FiBL
Main Challenges to obtain high quality seed of cultivars adapted to organic agriculture

- Very limited breeding initiatives to develop improved cultivars that are adapted to organic farming conditions with slow release nutrient supply
- Breeding is dominated by commercial sector while public breeding programs get reduced personnel and financial resources
- Organic breeding initiatives are not well connected with each others and conventional breeders
- Missing funding for organic plant breeding and research as focus is on molecular breeding
- Participatory breeding approaches need to be installed involving the farmers, regional communities and value chain
- Capacity building and empowerment of female farmers
- Improve self esteem of farmers to be proud to be the person who is feeding the society to prevent brain drain to cities
Main Challenges with respect to access to seeds

• **Concentration on the seed market**
  • Only 10 international companies control more than 60% of the commercial seed market
  • High influential power on seed regulation, UPOV regulation
  • Breeding is done for main crops that give good return of investment
  • Cultivars bred for broad adaptation and mainstream agriculture (one key fits all)
  • Overdominance of F1 hybrids to prevent farm saved seeds
Concentration on global seed market
Main Challenges with respect to access to organic seed of adapted cultivars

- **Loss of genetic resources**
  - Many genetic resources get lost as landraces and farmers get replaced by modern F1 hybrids
  - Public institutes withdraw more and more from breeding, seed multiplication, and gene bank collections
  - No systematic collection of farmers landraces and populations with local adaptation
    - If collected farmers are hesitant to provide seed, as they are afraid that it might be patented or someone else is commercialize it without benefit sharing with farmers
  - Small number of accessions are maintained in seed banks for in situ maintenance
  - Lack of secure storage facilities to safe seed (risk to loose a seed during storms, post havest losses (animals, insects, disease) and damage by moisture, heat)
Reduced number of crops and cultivar per crops

**FIGURE 5.1**
Use of crop species diversity in agriculture

- 3 major crops (maize, rice, wheat)
- 30 “feed the world”
- 200 entering statistics
- 7,000 used
- 30,000 edible
- 300,000 documented
- 400,000 plant species worldwide estimated

*Source: FAO, 1996*

---

John Tomanio, NGM Staff Food Icons, Quickhoney, Source Rural Advancement Foundation International
Main Challenges with respect to access to organic seed of adapted cultivars

• Legal restrictions as seed business is highly regulated
  • Nagoya protocol:
    • genetic resources belong to the state, they need to provide permission to collect genetic resources (prior informed permission)
  • International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) and Standard material transfer agreement (SMTA)
    • Multilateral systems, genetic resources entered there are available to all who participate
    • 1.1% of sales of products need to be paid in FAO funds
Main Challenges with respect to access to organic seed of adapted cultivars

• Legal restrictions as seed business is highly regulated
  • International Union for the Protection of New Varieties of Plants (UPOV)
    • UPOV 1978: breeders privilege and farmers rights for farm saved seed
    • Enforcement of UPOV 1991: breeder privilege, restricted farmers rights, only released varieties can be commercialized
  • Patents on plant species, cultivars, traits, genes, breeding procedures
    • National variety testing
    • New, distinct, uniform, stable (DUS test)
    • Value for cultivation and Use (VCU) tested under high input farming conditions
  • National seed law
Restriction of exchange of genetic material by IP rights

Overview of patent applications on plants under PCT/WIPO (WO) and at the EPO as well as of patents granted by the EPO. Research according to official classifications (IPC A01H or C12N001582).

Christoph Then & Ruth Tippe March 2012
www.no-patents-on-seeds.org

Who will control the Green Economy?
www.etcgroup.org
Increase of GM varieties

GLOBAL AREA OF BIOTECH CROPS
Million Hectares (1996 - 2010)

Source: James Clive 2011, ISAAA
www.fibl.org
CRISPR-Cas9 Development


www.fibl.org
Main Challenges with respect to access to organic seed of adapted cultivars

- Fast spread of cultivars derived from breeding technologies not accepted by IFOAM International
  - Discussion about these techniques binds many resources
  - Common position on GMO and new genetic engineering techniques
    - But is this position also supported by the organic farmers in different regions, do they know about it? Who informs them?
  - Cell fusion are banned by IFOAM in 2008 but 10 years later only few label organisations in Europe have actually put this ban into force
  - GMO crops take over seed market (e.g. Bt-cotton, RR-soybean, Bt-maize, …), non GM crops disappear from the local markets
  - Contamination of seed
  - No strategy to main genetic germplasm GMO free
Drift between conventional and organic plant breeding

The degree of overlap between conventional and organic suited cultivars depends on:

- Breeding goals & philosophy, Selection environment
- applied breeding techniques
Participatory Cultivar Evaluation and Participatory Breeding as a viable Alternative to Seed Monopoly

Formal plant breeding and seed supply

Participatory plant breeding and seed multiplication

One Way Information: Scientist
Extension Service Farmer

Society
Public & Private Breeding
Variety release
Seed Propagation
Seed traders Farmers

Economist
Climatologist
Agronomist
Social Scientist
Breeder
Seed producer
Trader
Customer
Politics
Society

FiBL www.fibl.org
Decentralized Participatory Plant Breeding

Needs strong facilitator to steer collaboration process, identify common goals and conflict of interest, translate between different actors, keeping collaboration and exchange moving.

Green Cotton Project (2013-2021): Participatory cotton breeding in India
www.greencotton.org

Bioimpuls Programme 2009-2013: Perspectives on Phytophthora-resistant potato varieties, Lammerts van Bueren et. al. 2013 Brochure
Founded as a result of last Pre-conference on Organic Seed in Istanbul in 2014 to move forward on the issue of seed and plant breeding in Organic Agriculture

- Support IFOAM World Board on all topics related to seed and plant breeding
- Connecting different seed and breeding initiatives
- Start global discussion on relevant topics
- Join forces for lobbying
- Integrate seed topics in IFOAM World Conferences
- Membership open for organisations (individuals) on all continents for good representation of the organic seed and plant breeding issues

IFOAM Seeds Platform <info@seeds.ifoam.bio>
Coordinated research for organic seed and plant breeding

35 partners
14 linked parties
18 countries

23 breeding & research institutes
7 breeding companies
8 seed companies
11 organic associations
Roadmap for organic seed of locally adapted cultivars

- Mobilise resources and finances!!!!
- Political lobbying for organic farming and the need for special cultivars
- Political awareness for improvement of legal regulations to improve access to seed and planting material
- Local capacity building and international networking
- Define priorities of crops and breeding goals for given region
- Identify local farmers and stakeholders to set up a seed and breeding network
- Identify enthusiastic facilitator !!
Thanks a lot for your attention

Come and visit us at the special exhibition on organic plant and animal breeding

ORGANIC RIGHT FROM THE START!
And meet several breeding initiatives and presentations on breeding

Messe Entrance: Mitte Foyer
Main Challenges with respect to access to organic seed of adapted cultivars

• Financing of organic plant breeding programs
  • Who owns the seed: open source, common good of defined community, national authorities, commercial companies, NPO
  • Who pays for plant breeding: until now farmers pay licences on seed sale to finance investment in breeding
  • For organic breeding initiatives 0 to max 15% is covered by licence derived from seed sale, more than 70% foundations
Contact

Research Institute of Organic Agriculture FiBL
Ackerstrasse 113 / Postfach 219
5070 Frick
Switzerland
Phone +41 62 8657-272
Fax +41 62 8657-273
info.suisse@fibl.org
www.fibl.org
Level of participatory research

Conventional
Research managed on station
or on farm trials

Consultative
Information sharing, farmers are consulted scientists take decision

Collaborative
Task sharing between farmers and scientists

Farmer managed
no scientists involved

→ Collegial: collective decision in group process, sharing responsibility and accountability

Gonsolves et al. 2005