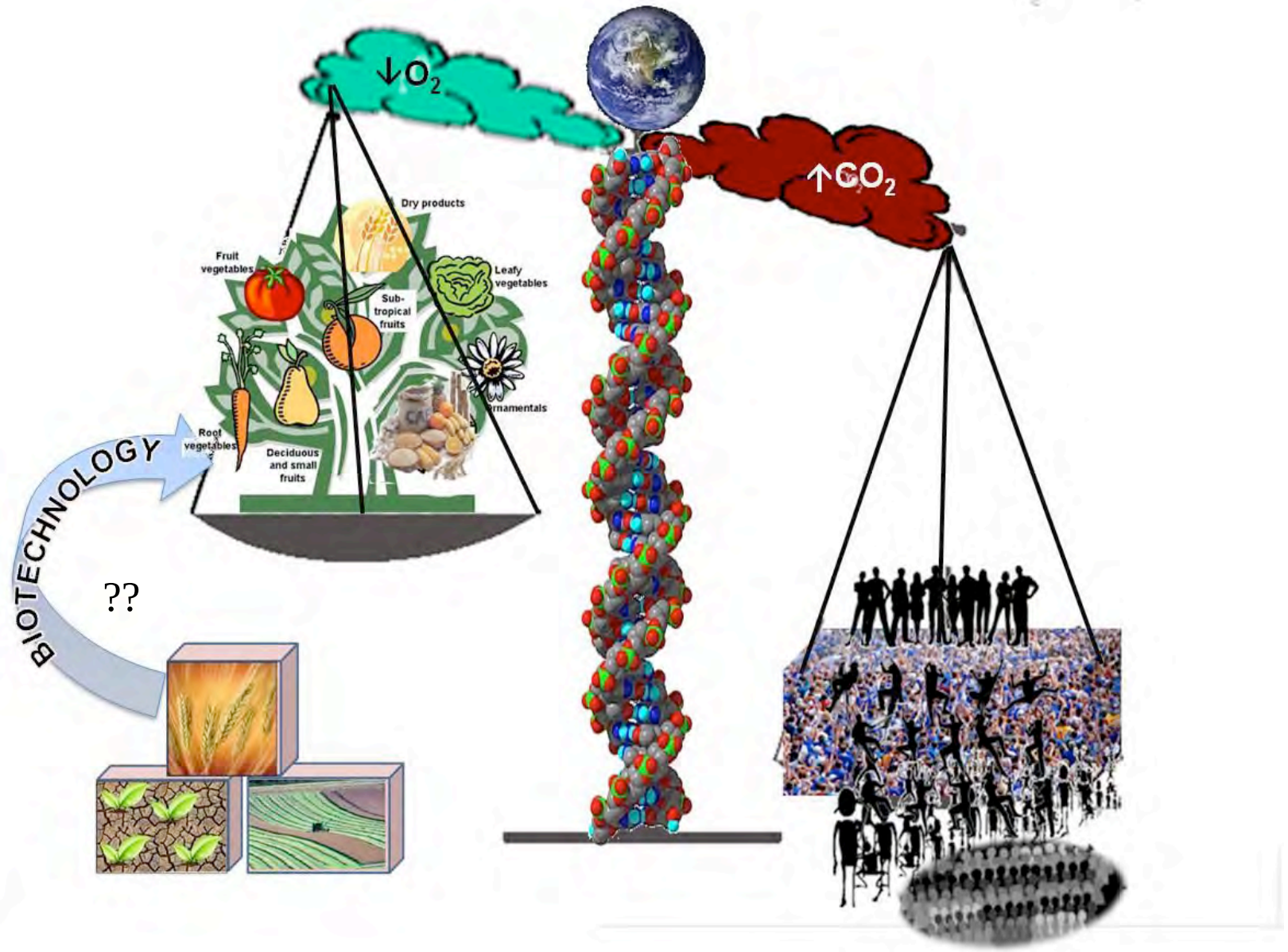
Agricultural Biotechnologies in Developing Countries

Capacity Building

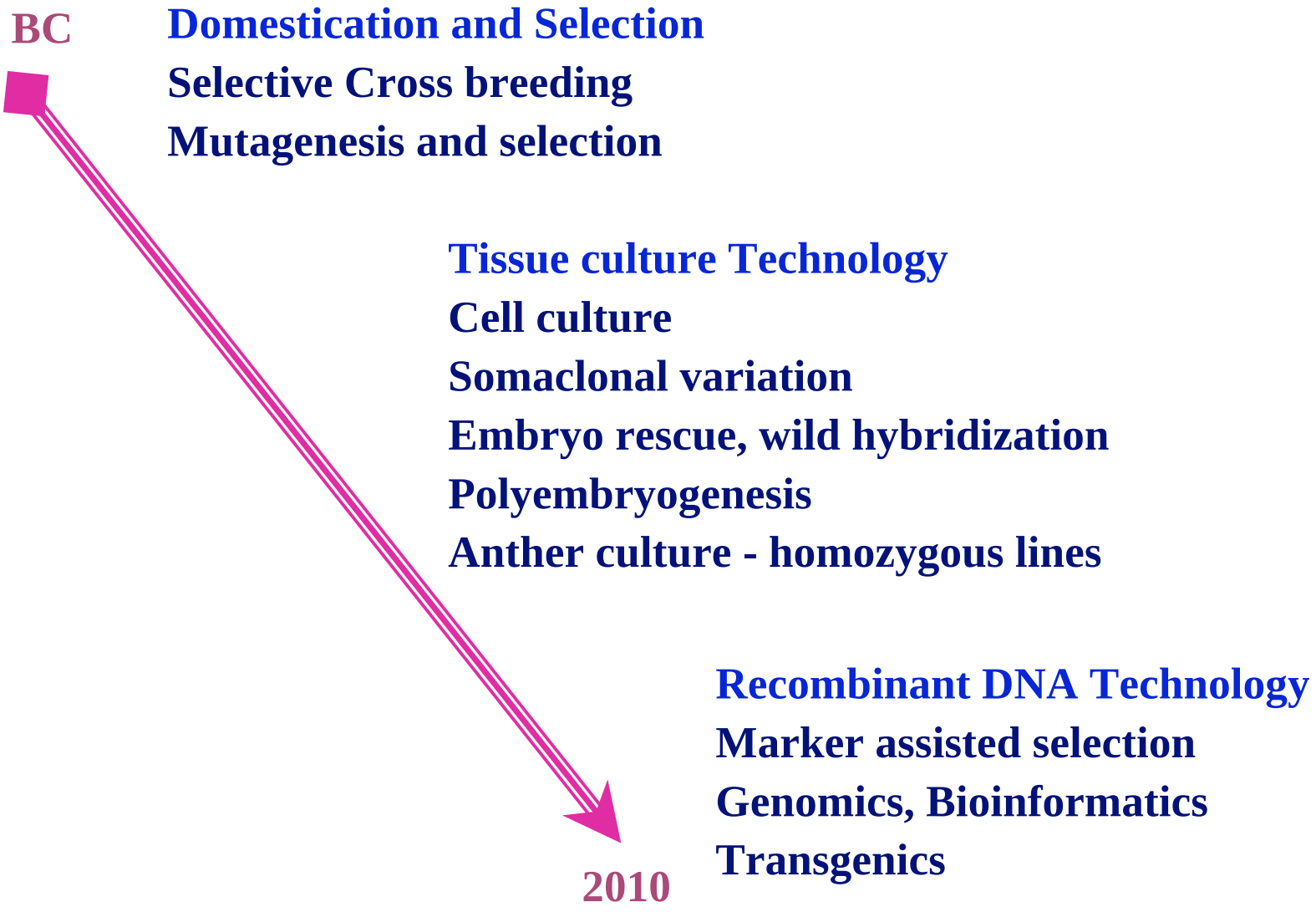
March 2, 2010

S.K.Sopory
New Delhi Component

The major Challenge: food security for ever increasing population under global climate changes



The Crop Agriculture Technology



First Development

The Green Revolution

Second Development

Hybrid Seeds

Third Development

Biotech Crops

Knowledge Revolution: in plant biology

(mostly in the developed world)

Knowledge Generation

Plant molecular biology: genes and their functions
genomics and epigenomics; microRNAs
System biology: protein-protein interactions
Plant responses to environment
Plant –pathogen interactions
Identifying QTLs/ markers for complex agricultural traits

Knowledege Applications and Management

Marker Assisted Breeding
Developing safe GM technology: virus/insect resistance

Capacity building required for:

1. **Preparing the mind for the future**:
   Students : Pre-degree/degree courses

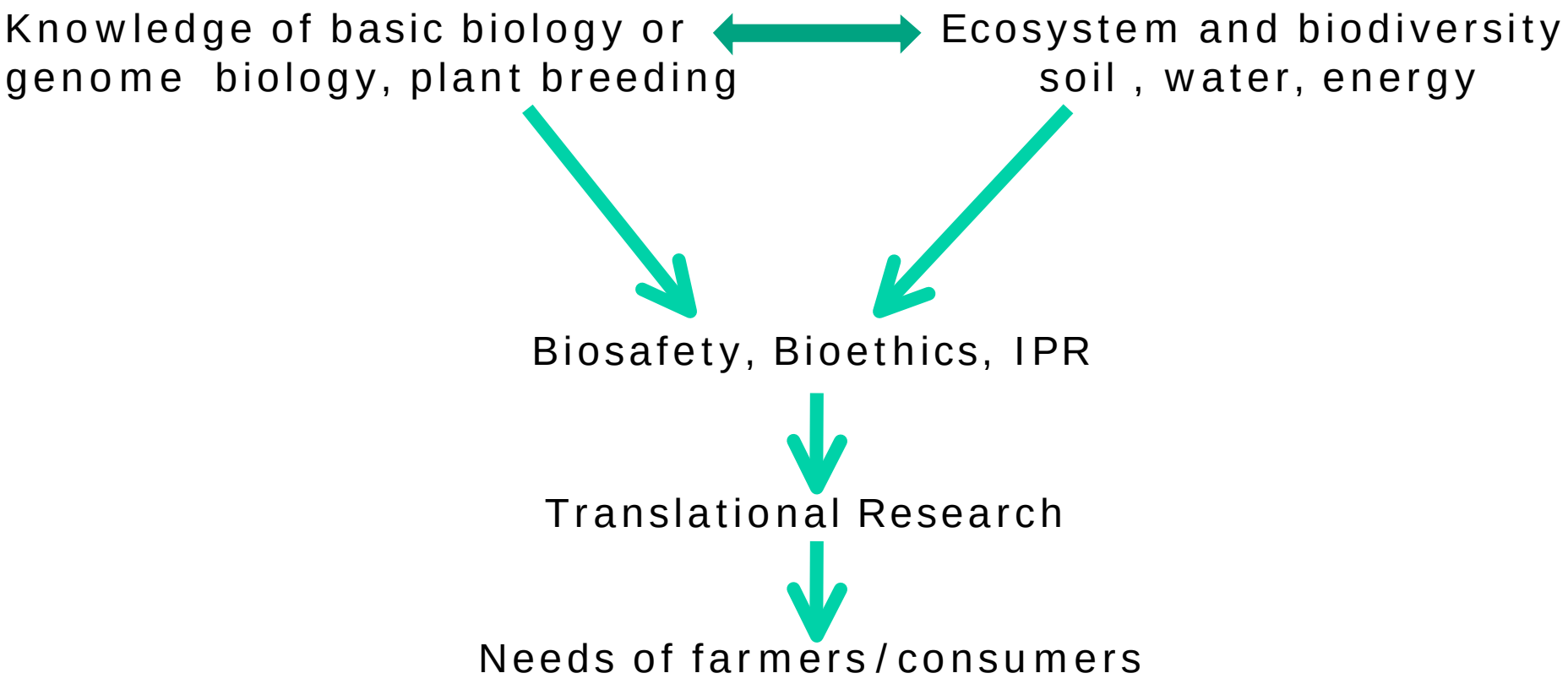
   Integrated teaching and practical training

2. **Researchers**: **to upgrade their training for new technology for suitable applications in their programs**

3. **Mid-career Teachers**: **to spread the education**

4. **Regulatory bodies and policy makers**

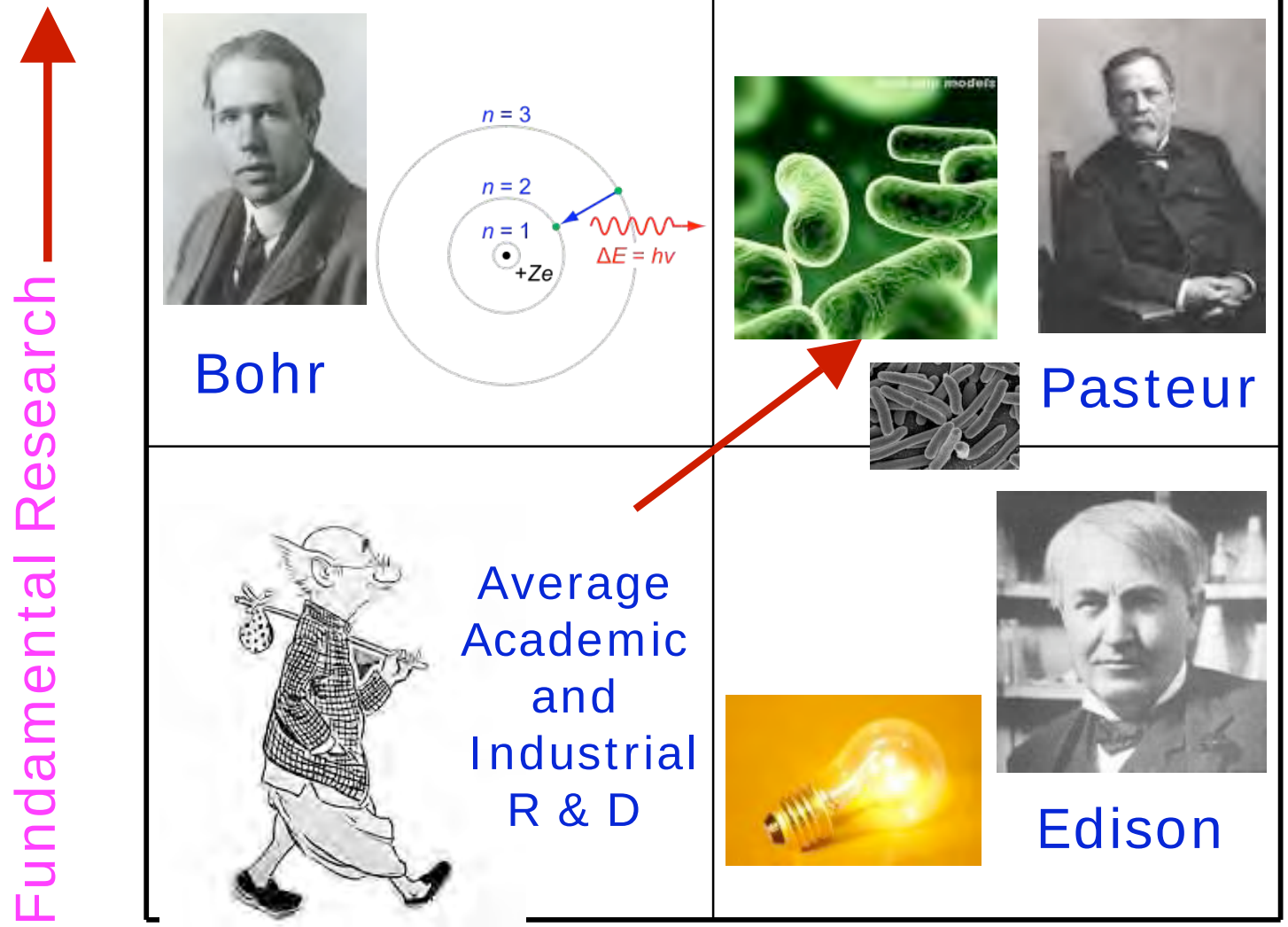
New Generation Agricultural Biotechnologist:



Graduate/undergraduate training should ensure that the learner.....

1. Understand science and research process
2. Ability to read primary literature
3. Understand how knowledge is constructed
4. Ability to analyze data
5. Interpretation of results
6. Readiness for research
7. Learning lab techniques
8. Tolerance for obstacles
9. Work independently
10. Learning ethical conduct
11. Skill in science writing
12. Self confidence
13. Effective oral presentation
14. Learn how to convert knowledge to wealth

Capacity building: can we produce original thinkers & scientific leadership in the developing world in the field of Agricultural biotechnology?



Capacity building in new biotechnologies for mid-career scientists

Work towards overcoming :

- **Limits to production on available land mass**
- **Balance in produce vs Population**
- **Malnutrition**
- **Deterioration in soil conditions**
- **Climate change related impact on agriculture**

Biotechnologies: Agriculture fast forward

Capacity Building needed in following areas

- **Phenotyping and genotyping the existing variability , biodiversity (markers, SNPs etc)**
- **Marker assisted breeding**
- **Genomics to identify gene(s) for resistant traits**
- **Genetic transformation technologies**
- **Safe biotech crops via genetic engineering**
- **Plant adaptation for “low input- high output” agricultural system**
- **Genomics to the rescue to local crops for increased productivity to enhance farm increases**

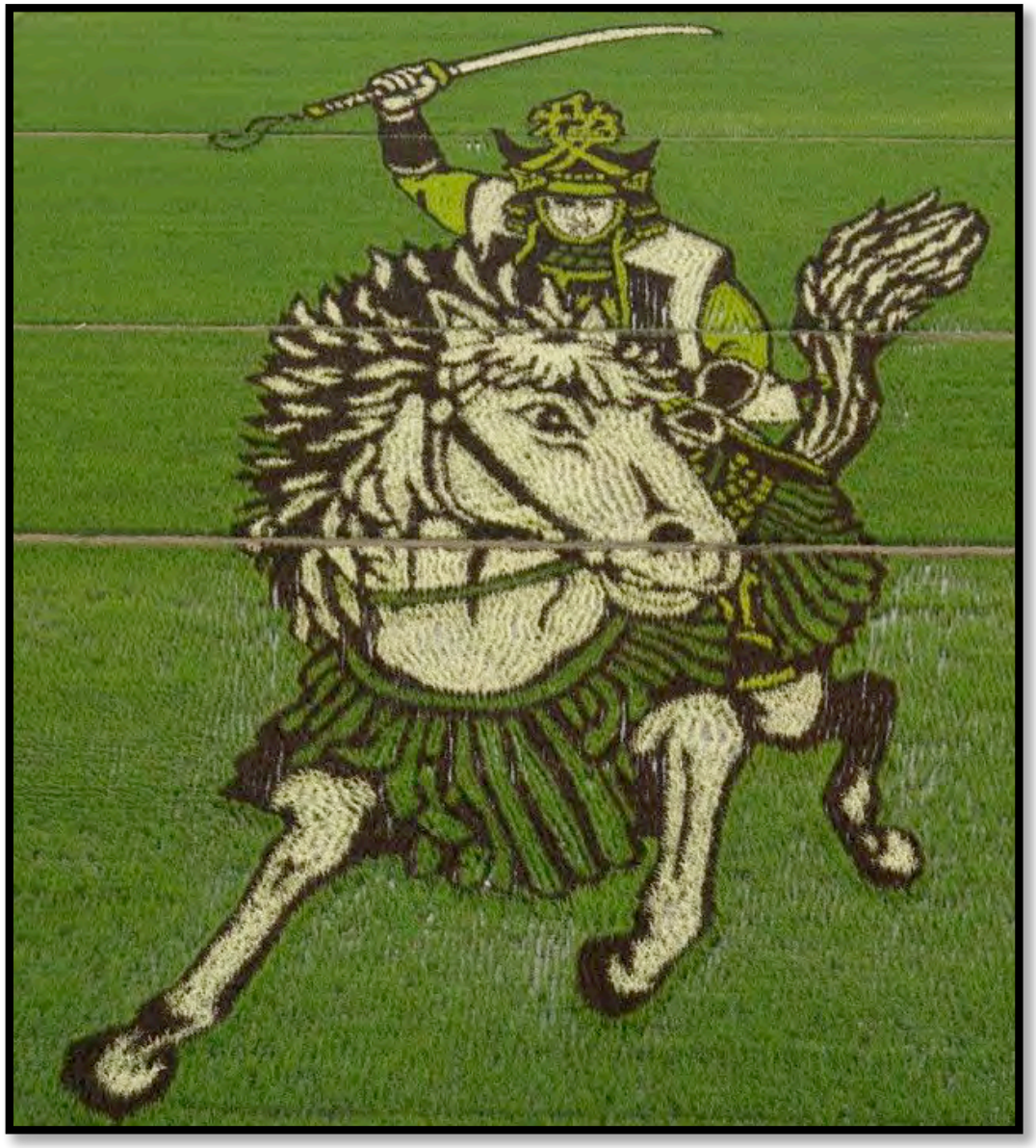
Capacity building: understand and bar code the country diversity

2010: International year of biodiversity

The farmers create the murals by planting little purple and yellow-leafed Kodaimai rice along with their local green-leafed Tsugaru, a Roman variety, to create the colored patterns in the time between planting and harvesting in September.

Napoleon on horseback can be seen from the skies.

This was created by precision planting and months of planning by villagers and farmers located in Inkadate , Japan



Partners in IPPN - the International Plant Phenomics Network

Australia
The Australian Plant Phenomics Facility
Adelaide 'Plant Accelerator' node
Canberra 'Australian High Resolution Phenomics Centre' node
Link to the website

France
Ecotron
CNRS Centre National de la Recherche Scientifique
Montpellier, France ; Link to the website

France
Ecotron
CNRS Centre National de la Recherche Scientifique
Montpellier, France ; Link to the website

Germany
Forschungszentrum Jülich , Jülich Plant Phenotyping Centre
Institute of Chemistry and Dynamics of the Geosphere (ICG)
Phytosphere (ICG-3) ; Link to the website

Canada

Biotron Experimental Climate Change Research Facility , The University of Western Ontario ,Canada
Link to the website

Canadian nation-wide research network for sustainable greenhouse gas management in agricultural production systems ; Link to the website

Capacity building in high end technologies

- to analyse the plant phenome, which results from the interaction between the genome of a plant and its present and previous environment

- to quantify plant performance in detailed, medium- and high-throughput applications

- for analysis of plant phenotypes and integrates them with sound environmental simulation and/or monitoring systems

- like genomics, transcriptomics, metabolomics or fluxomics to approach plant performance in the environment in a holistic way for basic as well as for applied research and its application

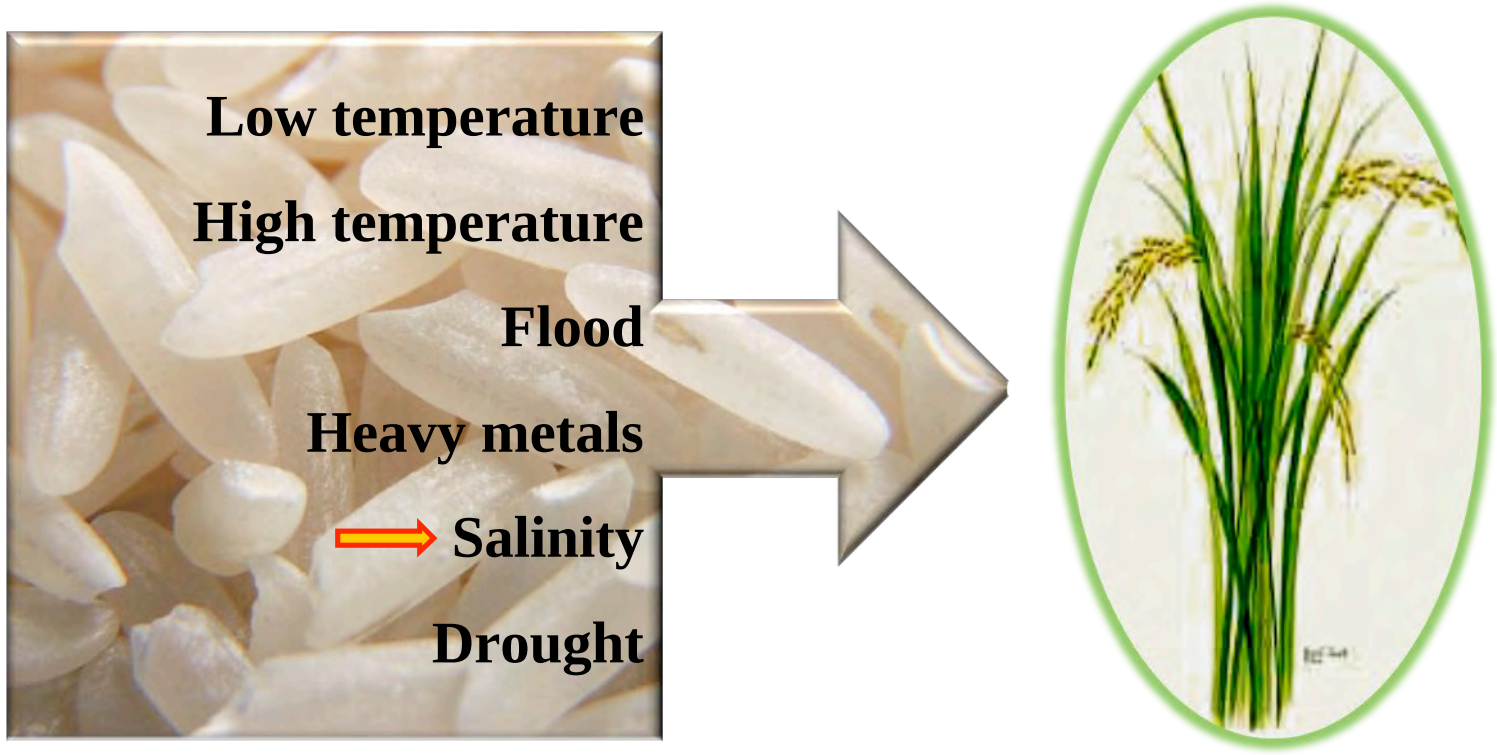
Enhancing capacities of mid-career scientists to face the problems due to climate change

Agricultural biotechnologists will have to deal with

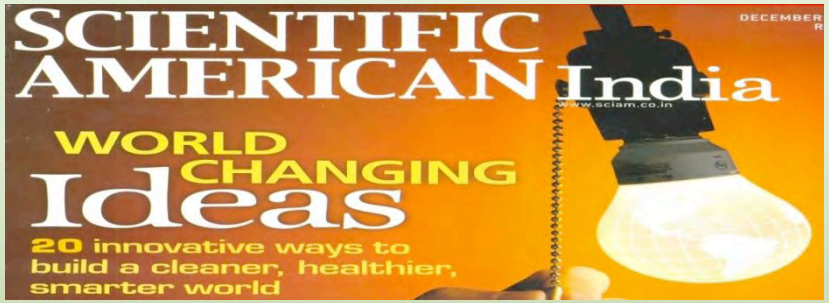
Less of : Water, Energy, Land

More of : Dry lands,
high saline soils
CO_2,
high Temperature

Work at ICGEB: Plant Stress Biology

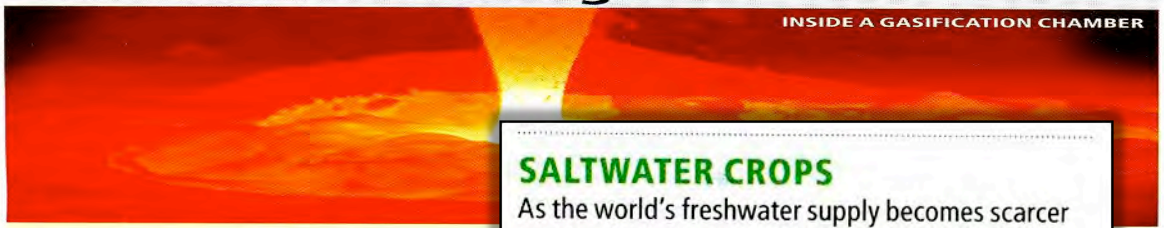


- **Physiological and Molecular basis of Stress tolerance/ susceptibility**
- **Development of stress tolerant plants *via* genetic engineering**



ENVIRONMENT

The Power of Garbage



Trapped lightning could h… electricity BY JOHN PAVL…

Trash is loaded with the energy trapp… nology that has been in developme…

In theory, the process is simple. Torche… ordinary air) in a chamber to create a supe… ture upward of 7,000 degrees Celsius, hot… naturally we call it lightning, and plasma … plasma's tremendous heat dissociates the… the chamber, converting organic compou… and hydrogen) and trapping everything el… be used as fuel in a turbine to generate el… nol and biodiesel. The slag can be process…

In practice, the gasification idea has b… municipal waste processing. But the matu… energy prices have been on the rise. Now … to take the trash to a plasma plant than it… Plasma Research at the Georgia Tech Rese… giant Waste Management partnered with … cializing the latter's plasma-gasification p… 1,000 daily tons of trash or more are unde…

Plasma isn't perfect. The toxic heavy m… Protection Agency's leachability standards… and France) but still give pause to commun… syngas-generated electricity has an unden… ton of trash you process with plasma, you … about two tons," Circeo says—it is still a n…

"It is too good to be true," Circeo admit… solid waste in the U.S. were processed with… 5 and 8 percent of our total electrical needs… our current hydropower output." With the … every day by 2020, using plasma to reclaim…

SALTWATER CROPS

As the world's freshwater supply becomes scarcer and food production needs balloon, salt-tolerant crops could ease the burden. Researchers at Australia's University of Adelaide used genetic engineering to enhance a model crop's natural ability to prevent saline buildup in its leaves, allowing the plant to thrive in conditions that would typically wither it. If the same gene tweak works in cereal crops such as rice (*below*) and wheat—the researchers are testing them now—fallow lands destroyed by drought or overirrigation could become new breadbaskets.

ENVIRONMENT

MORE IDEAS TO WATCH

BY JOHN PAVLUS

CEMENT AS A CARBON SPONGE

Traditional cement production creates at least 5 percent of global carbon dioxide emissions, but new materials could create carbon-neutral cement. Start-up Novacem, supported by Imperial College London, uses magnesium oxide to make cement that naturally absorbs CO_2 as it hardens. California-based Calera uses seawater to sequester carbon emissions from a nearby power plant in cement.

THE NEW HONEYBEE

Colony collapse disorder (CCD) has killed more than a third of honeybee colonies since 2006. Farmers who depend on bees to pollinate such crops as almonds, peaches and apples are looking to the blue orchard bee to pick up the slack.

One efficient *Osmia lignaria* (*left*) can pollinate as much territory as 50 honeybees, but the bees are harder to cultivate because of their solitary nature. These pinch hitters won't completely replace honeybees, but as scientists continue to grapple with CCD, they could act as an agricultural safety net.

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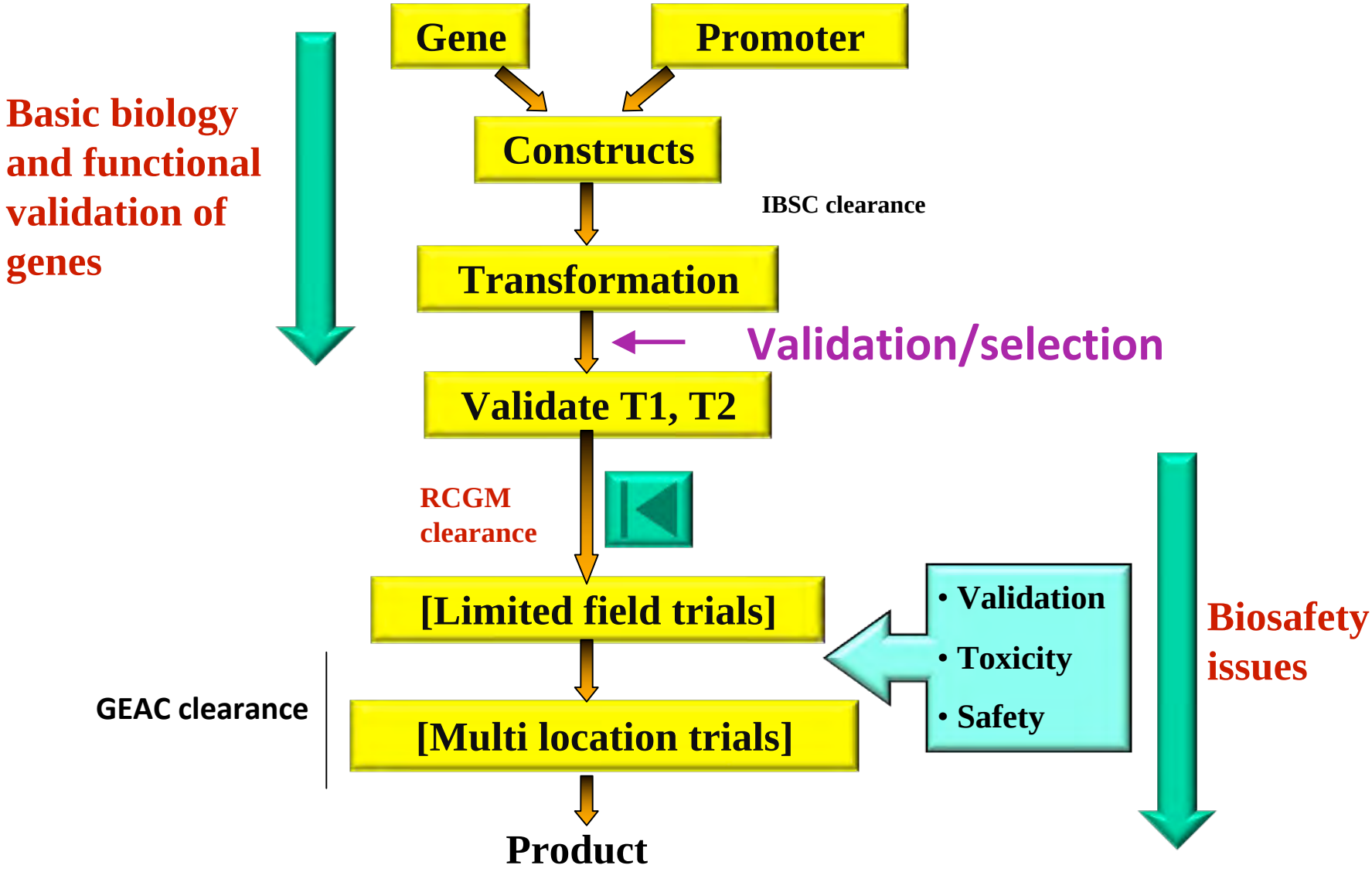
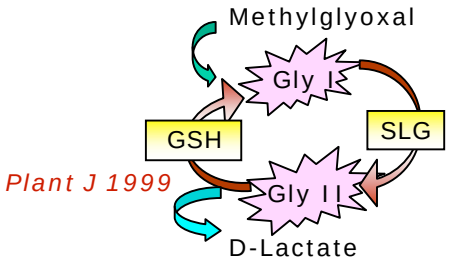
Biotech Crops: bench to business



Discovered novel genes/pathways

DATABASE OF STRESS REGULATED GENES GENERATED

A. GLYOXALASE PATHWAY



Plant J 1999

WT GI GII GIGII

PNAS (USA) 2003

To RICE

Transgenic Res 2008

To SEED COMPANY

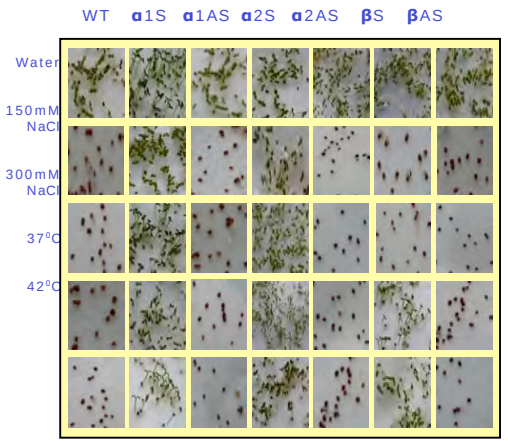
B. HELICASE / EIF2

WT PDH45

PNAS (USA) 2005

To RICE

C. G-PROTEINS & PLC



Plant J 2007

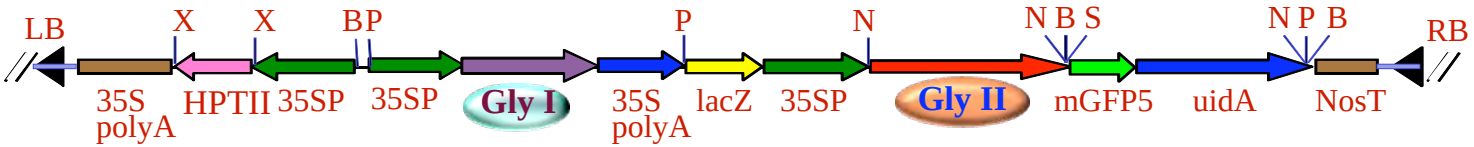
D. NOVEL CBS domain containing proteins

BMC genomics 2009

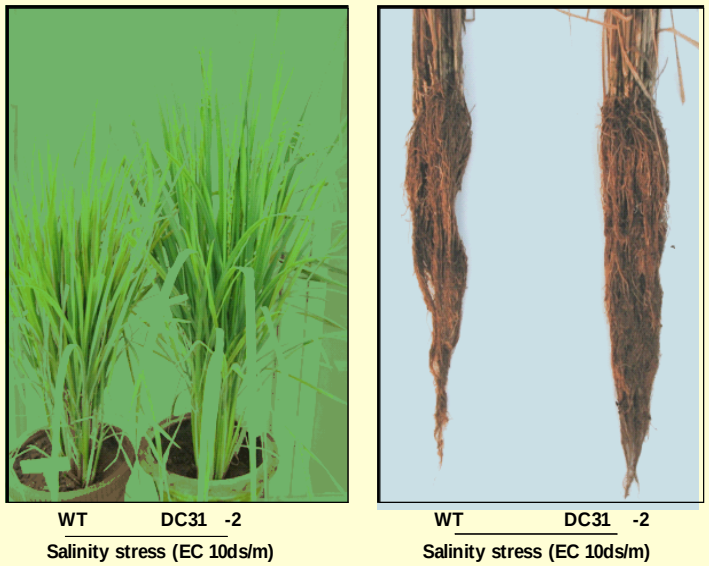
To TOBACCO

Gly rice: Salt and drought tolerant rice

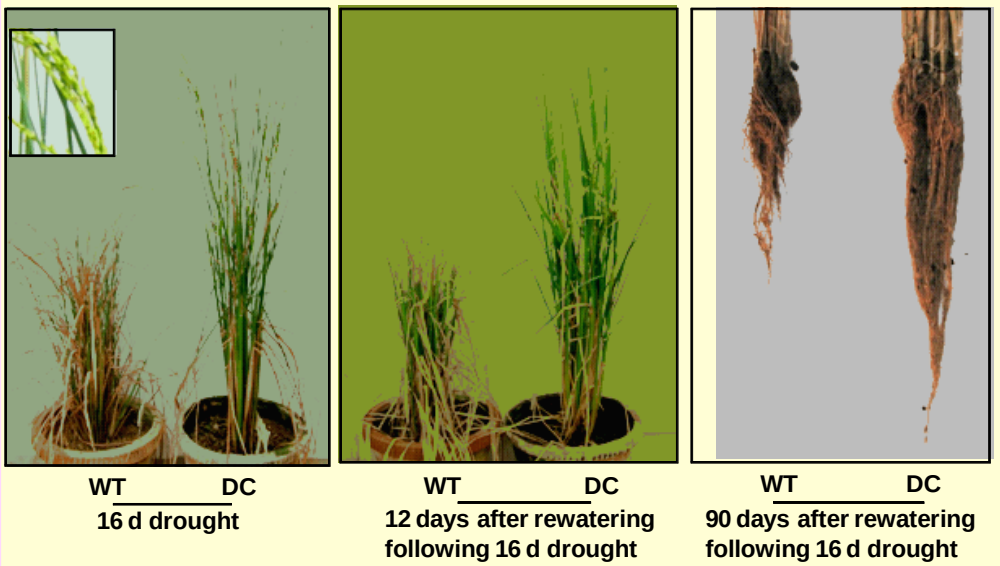
Double construct : pCAMgIgII



Salinity tolerance



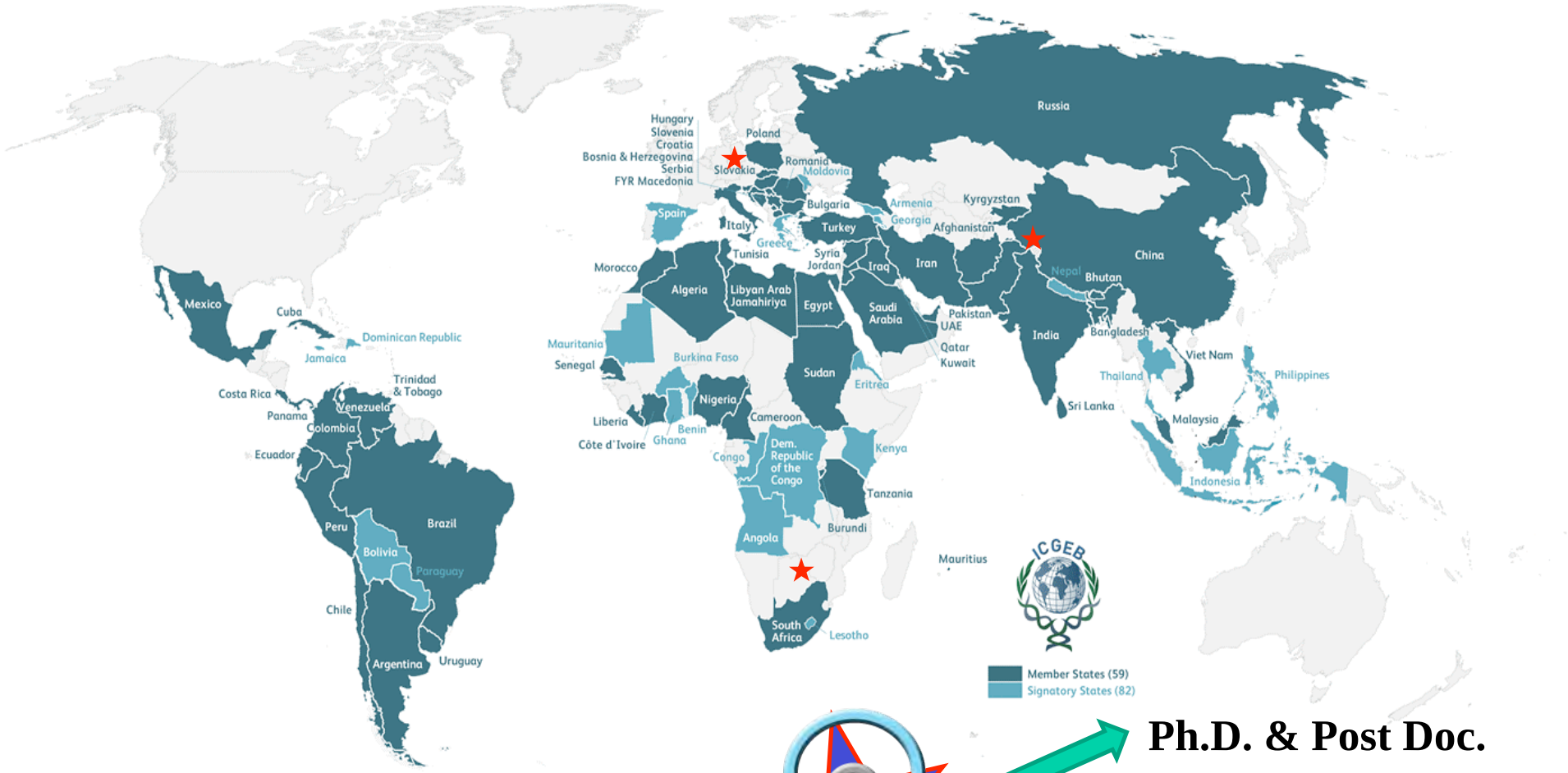
Drought tolerance



Developing marker free and reporter free stress tolerant rice

To grow more plants under stress conditions:

Biotech training at ICGEB



Ph.D. & Post Doc.

Workshop

Short term training

Collaborations established under ICGEB-TWAS Program

1. **Sabina Vidal Macchi** *Universidad de la Republica* ,Montevideo,Uruguay
   Virginia Luna,Unicersidad Nacional de Cordoba, Argentina
   Laszlo Szabados ,Institute of Plant Biology,Szeged,Hungary
   Aldo Rojas ,Managua, Nicaragua.

2. **Andres Zurita Silva,** Centre of Advanced Studies in Arid Zones, La Serena, Chile
   Sara Maldonaldo, University of Buenos Aires, Argentina
   Amadou Coulibaly, University of Mali, West Africa
   Fabiana Antognoni,University of Bologna, Italy.

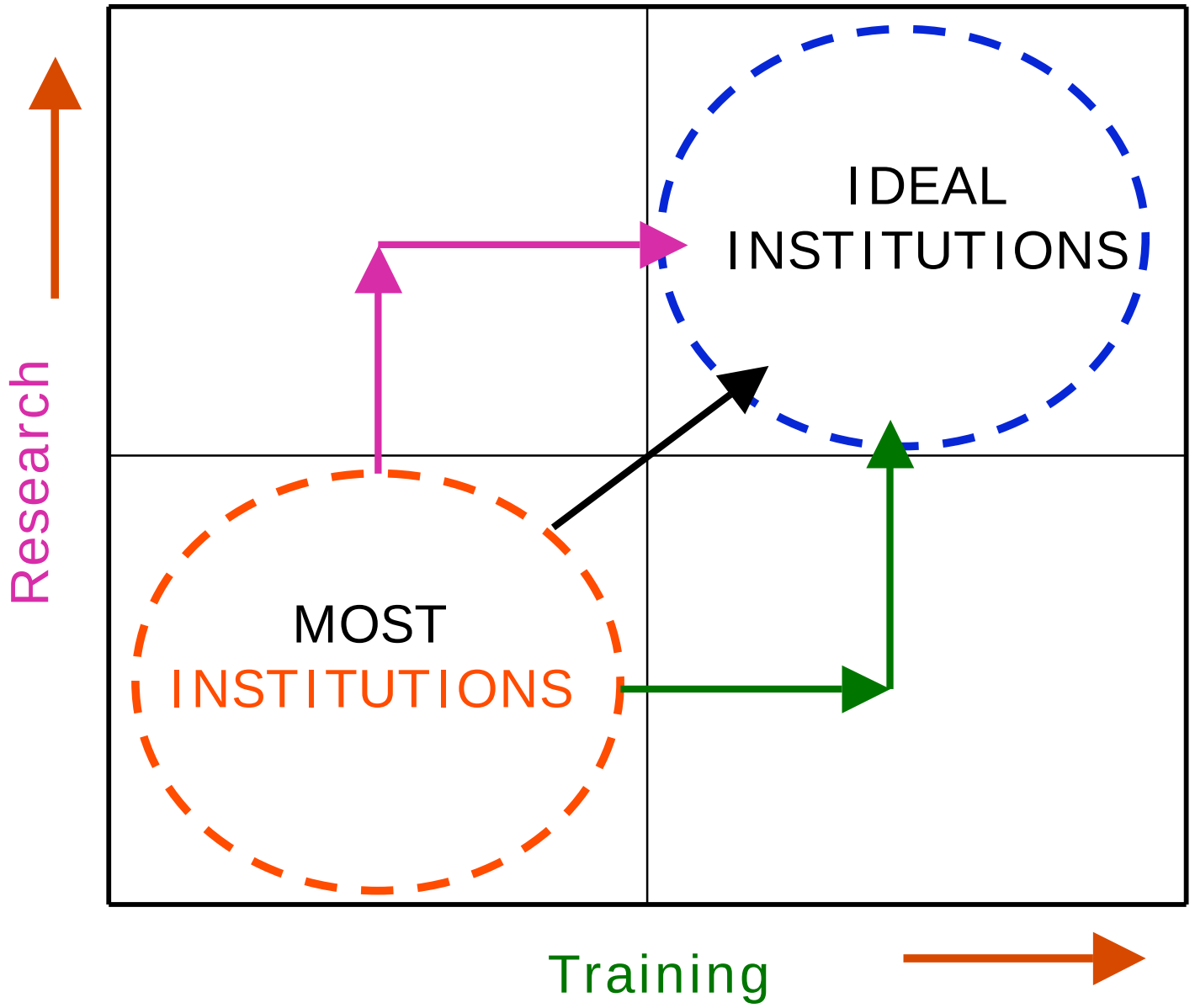
3. **Jennifer Ann Thompson,** Deptt.of Cell and Molecular Biology, University of Cape Town , South Africa, Dahlia Garwe, Molecular and Cell Biology Division, Harare, Zimbabwe
   Jesse Machuka, (Steven Runo), Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya

4. **Khaled Masmoudi,** Centre de biotechnologie de Sfax, Tunisia
   Michael Baum, ICARDA, Syria
   Eric Danquah, Deptt. Of Crop Science, University of Ghana.

5. **Konstantin Skryabin ,** Nikolai Ravin, Andrey Rakitin, Centre “Bioengineering” of Russian Academy of Sciences, Moscow, Russia
   Zafar Ismailov, University of Samarkand, Uzbekistan

Xuan Hoi Pham: Department of Plant Molecular Pathology and Stress tolerance, Institute of Agricultural Genetics, Vietnam

ICGEB Goal: Help in the pursuit of excellence



A.P.J. Abdul Kalam: Former President of India on capacity building

1.Research and Enquiry

Management of knowledge and information

2. Creativity and Innovation

Move out of individual and shift into the realm of network

3.Capacity to use high technology

4.Entrepreneurship

Aptitude to be cultivated in the University environment

5. Moral leadership

Vision of human betterment

Dream is not what you see in sleep……..

……..is the thing which does not let you sleep!

With better trained agriculture scientists and Govt. support we hope we do not get these messages in future

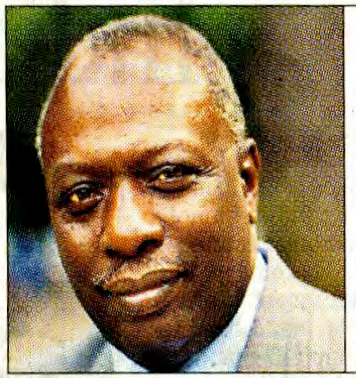
Just enough food to last 2-3 months

World Facing Severe Crisis, Says FAO chief; Pawar Allays Fears In India

New Delhi: The world had just about enough cereal stocks to feed the global population for two to three months. With a crisis looming worldwide, food prices too are far from coming down, the United Nations' Food and Agriculture Organisation revealed on Wednesday.

"The rise in prices of food commodities all over the world will not ease in the short term in view of supply-demand situation," FAO director general Jacques Diouf told reporters after meeting agriculture minister Sharad Pawar.

Diouf said the world has 4-5 million tonne of cereals stocks that can feed the global population for only 8-12 weeks. "The world food situation is very serious today with food riots reported from many countries like Egypt, Cameroon, Haiti, Burkina Faso and Senegal. We fear that this may spread to other countries," he added.



> "World food prices have risen 45% in the last nine months and there are serious shortages of rice, wheat and maize... Some serious steps are required to come out of the situation"
>
> **Jacques Diouf** | FAO CHIEF

"World food prices have risen 45% in the last nine months and there are serious shortages of rice, wheat and maize," Dious said.

Diouf noted that people in the developing countries spend 50-60% of their income on food and therefore, any rise in food prices affects them. He attributed the increasing demand from developing countries, particularly in China and India, and diversion of food grains towards production of bio-fuels to rising commodity prices across the world.

However, Pawar expressed confidence that India's food situation was comfortable.

"We have over half a million tonne of food grain surplus than the buffer norms as on April 1," Pawar said. According to Food Corporation of India, the wheat stock as on April 1 is 5.5 MT against the buffer norm of 4 MT. AGENCIES

Thanks

Prime Minister Manmohan Singh at 92nd session of Indian Science Ahmedabad

"First, I am concerned by the fact that our best minds are not turning to science, and those who do, do not remain in science….

On the one hand, we are truly proud of the fact that this year, all the nineteen young boys and girls who represented India in Olympiads, came back with medals. On the other hand, our past record shows that practically none of such Olympiad medal winners pursued science subsequently as a career! We must reverse this trend."