

ICAR norms for research in agriculture



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India's tryst with destiny



“Everything else can wait,
but not Agriculture”

Jawaharlal Nehru, August 14-15, 1947

Agriculture is the Greatest Living,
Private Sector Industry of India
providing Livelihood to over 600
million persons

- **The Indian National Agricultural Research System is one of the largest systems in the world** in respect of human source engagement and infrastructure, **and the Indian Council of Agricultural Research (ICAR) is the apex body of this system.**
- **The Council** administratively, **is an autonomous organization**, under the Department of Agricultural Research and Education, & Ministry of Agriculture, Government of India.
- The ICAR coordinates, guides, and manages research, education, and extension services in agriculture, including crops, horticulture, agroforestry, fisheries, and animal sciences



Core Assets of ICAR

- It has a vast network of 96 ICAR institutes, 77 All India Coordinated Projects/Networks, four deemed to be universities, two Central Agricultural Universities, and 641 Krishi Vigyan Kendras (KVKs) spread across the country.
- In addition, there are 62 state Agricultural/Veterinary/Horticultural/Fishery universities and 4 general universities with agricultural faculty, as part of the NARES.



Basic Information

Name of the Country	India
Reporting Agency	Indian Council of Agricultural Research
Value of GDP in local currency	*152.18 trillion INR
Value of GDP in USD	*2.26 trillion USD
Value of Agriculture GDP in local currency	*25.87 trillion INR
Agriculture GDP as percent of GDP	*17%
Total investment in Agriculture Research in local currency	Approximately Rs 7000 crores
Total investment in Agriculture Research in USD	Approximately \$ 1000 million
Total investment in Agriculture Biotechnology Research in local currency	Approximately Rs 1000 crores
Total investment in Agriculture Biotechnology Research in USD	Approximately \$ 150 million

Sustainable Food Production

- **“Intensive cultivation of land without conservation of soil fertility and soil structure** would lead ultimately to the springing up of deserts.
- Irrigation without arrangements for drainage **would result in soils getting alkaline or saline.**
- **Indiscriminate use of pesticides, fungicides and herbicides** could cause adverse changes in biological balance, as well as lead to an increase in the incidence of cancer and other diseases, through the toxic residues present in the grains or other edible parts.

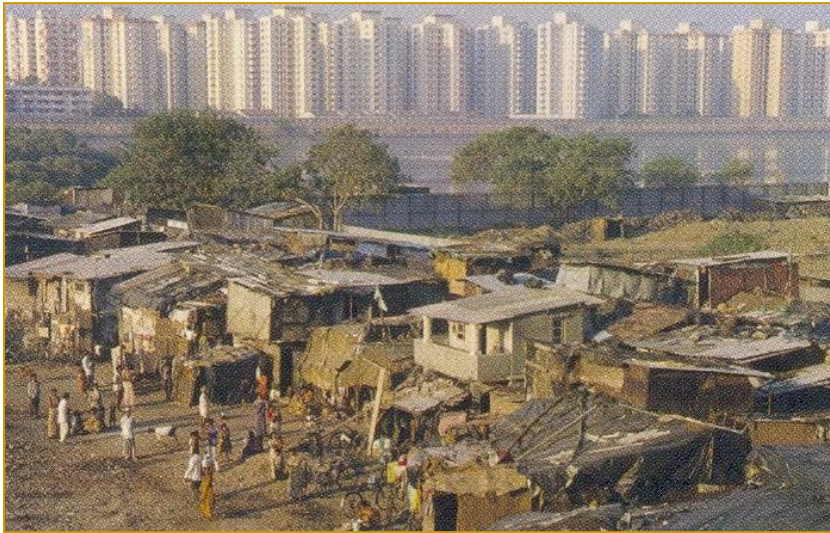
- Unscientific tapping of **underground water** would lead to the rapid exhaustion of this wonderful capital resource , left to us through ages of natural farming.
- The rapid replacement of numerous **locally adapted varieties** with one or two high-yielding strains, in large contiguous areas, would result in the spread of serious diseases, **capable of wiping out entire crops**, as happened prior to the Irish potato famine of 1845 and the Bengal rice famine of 1942.

- Therefore, the initiation **of exploitative agriculture without a proper understanding** of the various consequences , of every one of the changes , introduced into traditional agriculture
- **and without first building up a proper scientific and training base** to sustain it, may only lead us, into an era of agricultural disaster in the long run, rather than to an era of agricultural prosperity.”

Some questions we face in Biology today

Will Malthus Continue to be Wrong?

We need to set priorities, understand the reasons that make ecosystems resistant or vulnerable; also whether stressed ecosystems, such as marine fisheries, have a threshold at which they won't recover



India will be the most populated country in the world by 2030

What don't we know? 1 July 2005 Vol 309 Science

Green Revolution and Evergreen Revolution : Pathways

<p>Green Revolution: Commodity-centred increase in productivity</p> <p>↓</p> <p>Change in In-plant architecture, and harvest index</p> <p>Change in the physiological rhythm insensitive to photoperiodism</p> <p>Lodging resistance</p>	<p>Evergreen Revolution: increasing productivity in perpetuity without associated ecological harm</p> <p>↓</p> <p>Organic agriculture: cultivation without any use of chemical inputs like mineral fertilizers and chemical pesticides</p> <p>Green Agriculture: cultivation with the help of integrated pest management, integrated nutrient supply, and integrated natural resource management systems</p> <p>Ecoagriculture: Based on the conservation of soil, water, and biodiversity and the application of traditional knowledge and ecological prudence</p> <p>EM Agriculture: a system of farming using effective microorganisms (EM)</p> <p>White agriculture: System of agriculture based on substantial use of microorganisms, particularly fungi</p> <p>One-straw Revolution: a system of natural farming without plowing, weeding, chemical fertilizers, pesticides and herbicides</p>
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Emphasis is on green biotechnologies (concerning plants and their growing) as well as on white biotechnologies (primarily focusing on the use of biological organisms to produce or manipulate things).



Environment (Protection) Act 1986 & Rule 1989

- ✦ Ensure safety from the use of (GMOs) and products thereof in research and application to the users as well as to the environment
- ✦ A three tier mechanism
- ✦ Institutional Biosafety Committees (IBSC) at the Institute/ company.
- ✦ Review Committee on Genetic Manipulation (RCGM) in the Department of Biotechnology.
- ✦ Genetic Engineering Approval Committee (GEAC) in the Ministry of Environment & Forests (MoE&F).
- ✦ Granting approval for R&D activities on r-DNA products, environmental release of GE crops and monitoring and evaluation of research activities involving r-DNA technology.

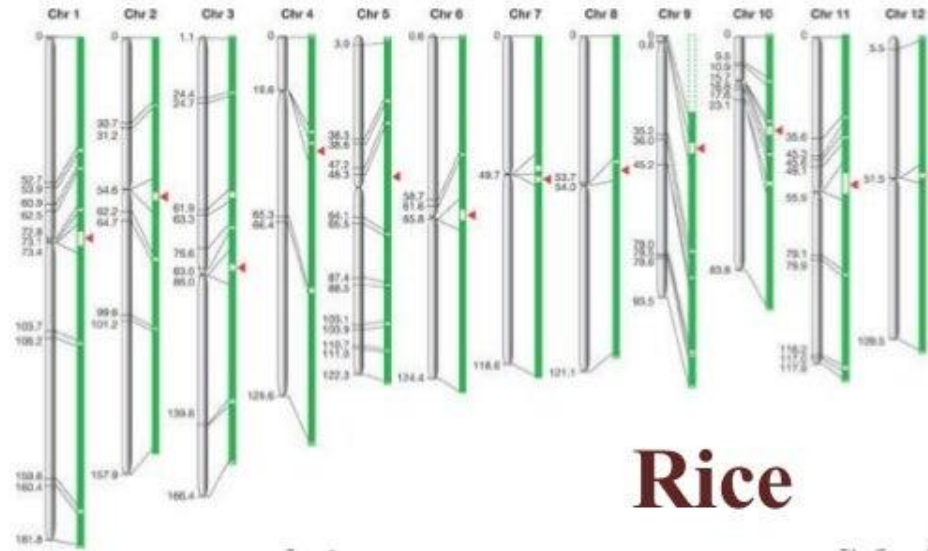
Statutory Bodies under EPA 1986

- ✚ The Recombinant DNA Advisory Committee (RDAC)
- ✚ Institutional Biosafety Committee (IBSC)
- ✚ Review Committee on Genetic Manipulation (RCGM)
- ✚ Genetic Engineering Approval Committee (GEAC)
- ✚ State Biotechnology Coordination Committee (SBCC)
- ✚ District Level Committee (DLC).

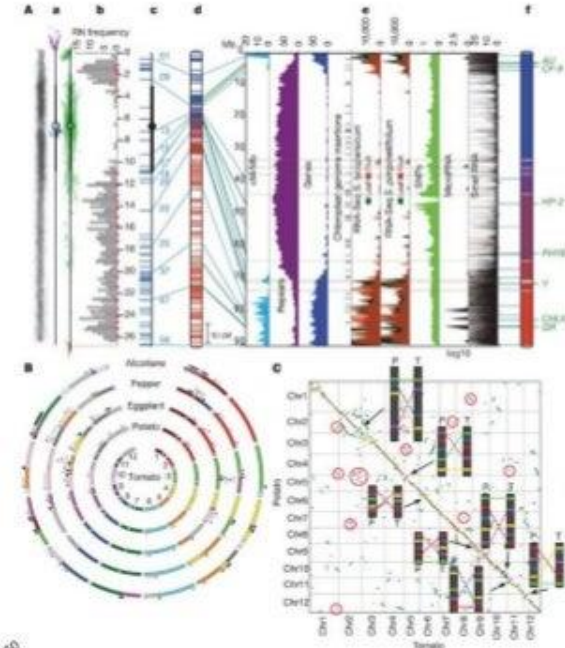
National Biotechnology Development Strategy

- ✦ Ensure safety from the use of (GMOs) and products thereof in research and application to the users as well as to the environment
- ✦ First National Biotechnology Development Strategy in September 2007
- ✦ “The National Biotechnology Development Strategy-2015-2020” was announced in 2015 (referred as ‘Strategy-II)
- ✦ formulated and developed on the earlier strategy to accelerate the pace of growth of biotechnology sector at par with global requirements.

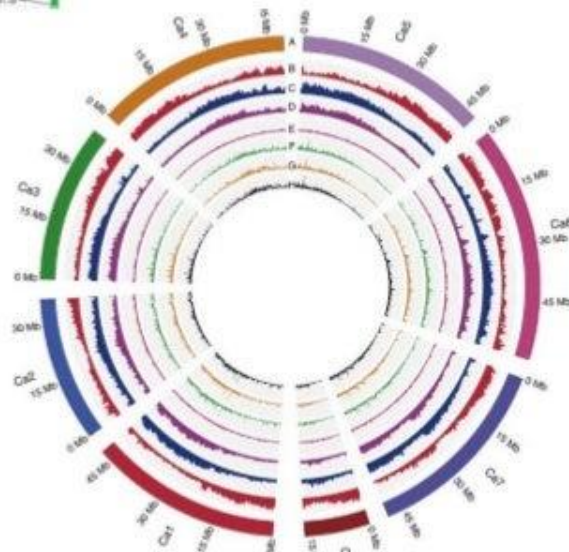
Crop Genome Sequence



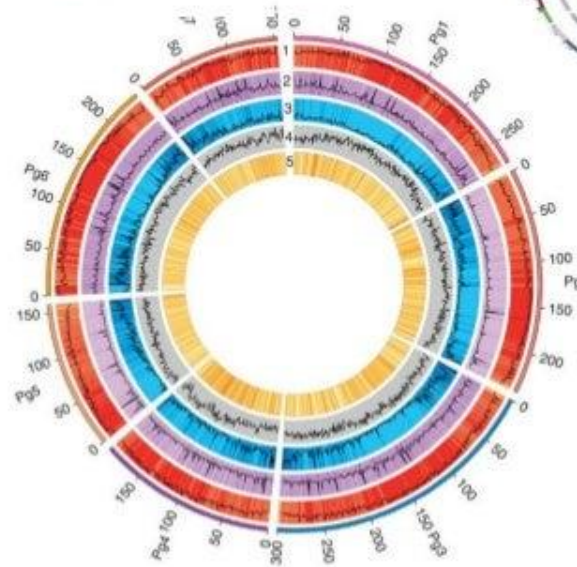
Rice



Tomato



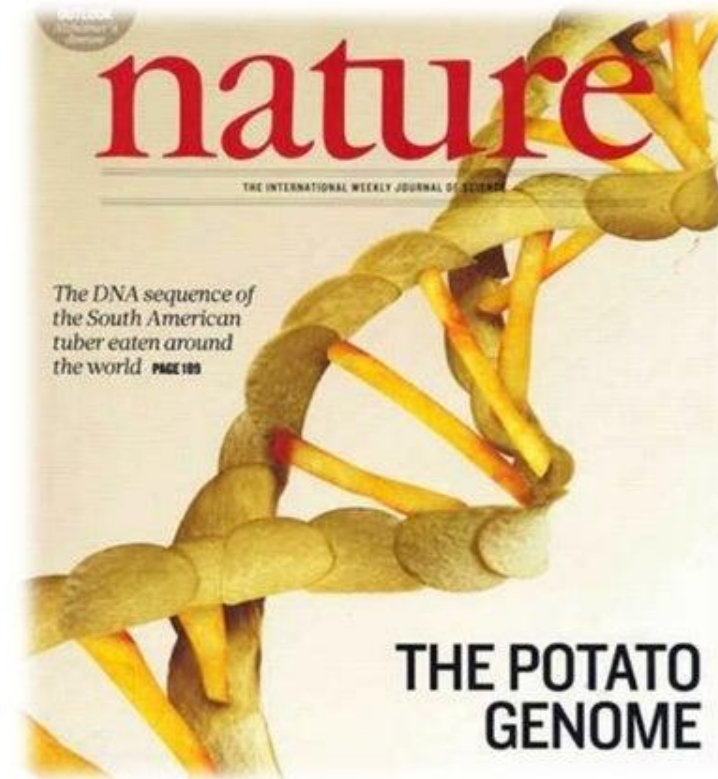
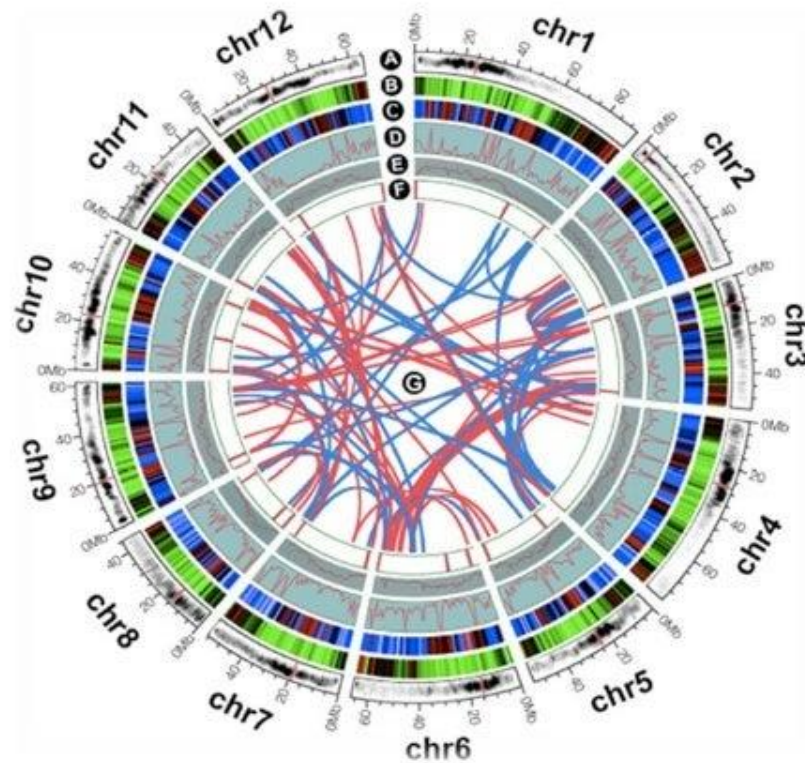
Chickpea



Pigeon pea

Potato Genome Sequence

The complex genome of potato has been deciphered by a consortium of 26 international institutes belonging to 14 countries including ICAR-CPRI, Shimla from India. **A total of 39,031 protein-coding genes were predicted** in the sequence out of which about 800 genes encode disease-resistance related proteins.

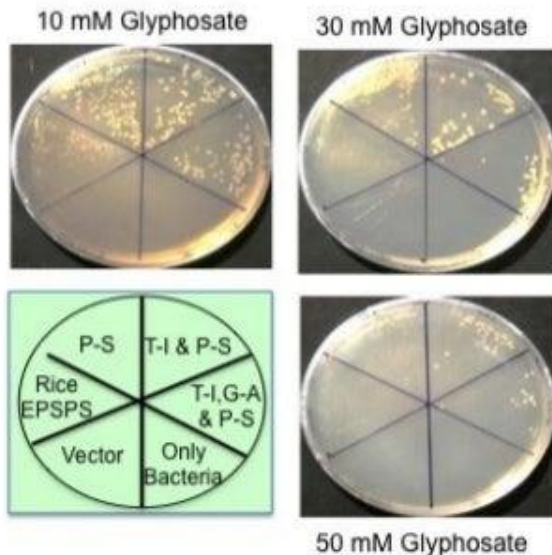


Genome sequencing in progress:

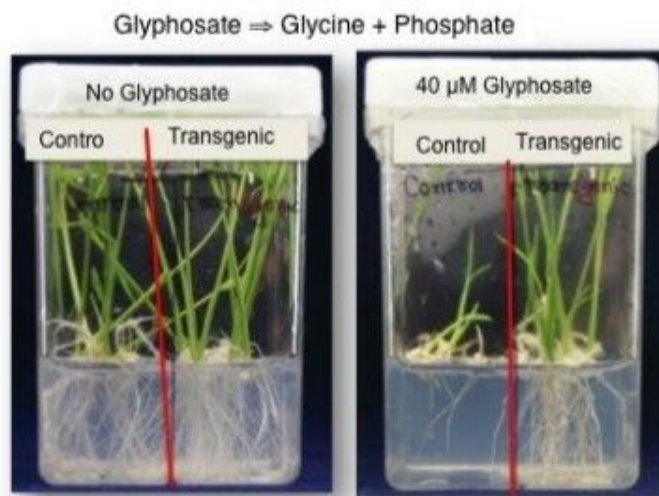
- | | | |
|---------------------------|-------------------------|-------------------------|
| 1. <i>R. solanacearum</i> | 3. <i>S. chacoense</i> | 5. <i>S. scabies</i> |
| 2. <i>P. infestans</i> | 4. <i>F. sambucinum</i> | 6. Major potato viruses |

Herbicide tolerant transgenic rice for weed management

Multisite compensating mutations in rice EPSPS to confer glyphosate tolerance



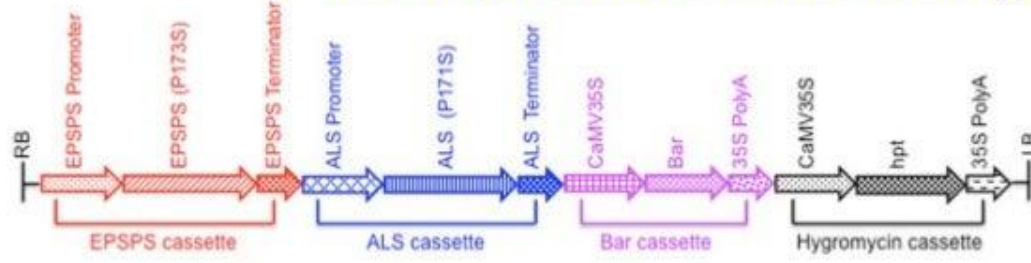
IgrA gene from *P. aeruginosa* when expressing in transgenic rice showing glyphosate tolerance



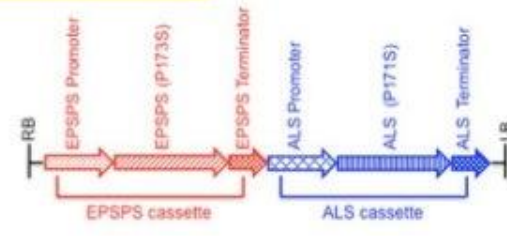
- ✦ The rice EPSP synthase (P173S) and acetolactate synthase (P171S) were mutated.
- ✦ The mutated EPSP synthase (P173S) and ALS (P171S) genes were transformed and stable rice transgenic rice lines tolerance to glyphosate and sulfonylurea developed without any fitness cost.
- ✦ Both the double and triple mutants confer higher tolerance to glyphosate

Double herbicide tolerant transgenic rice Plants

With Antibiotic
Marker Hygromycin



Without Antibiotic
Marker



Glyphosate
Post-Emergent Application

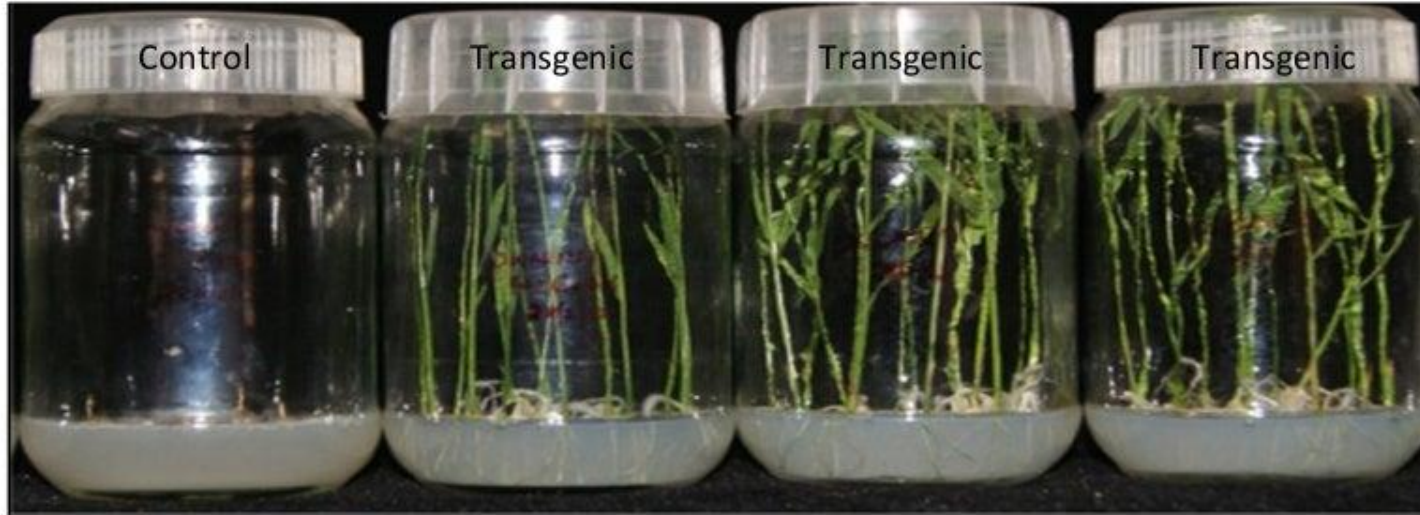


Control



Transgenic

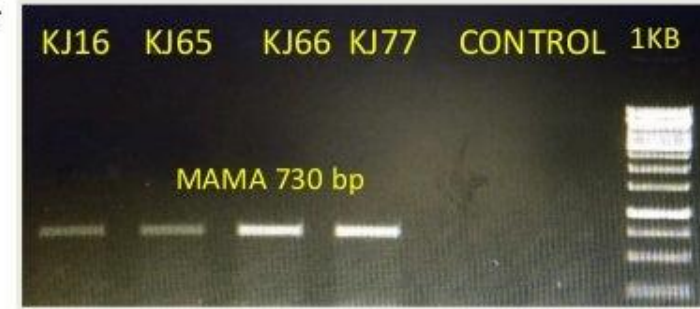
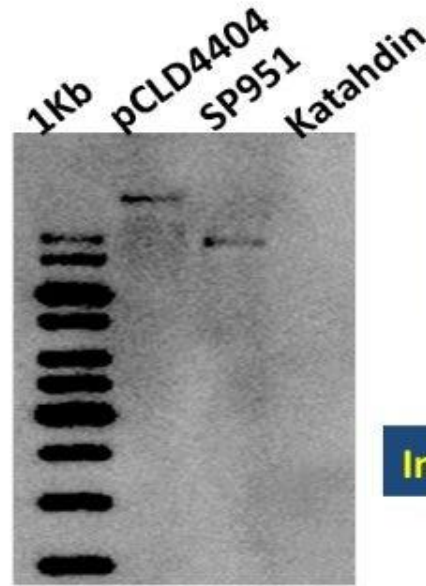
Sulfonylurea
Pre-Emergent Application



RB transgenic potato for late blight resistance

❖ The *RB* gene from *S. tuberosum* received under ICAR-ABSP-II collaborative project was utilized to develop transgenic potato with durable late blight resistance.

❖ Application submitted to RCGM for conducting BRL trials in consultation with BCIL



Integration and inheritance of RB gene



Based on yield potential and Late blight resistance selected five promising hybrid

Improved Pusa Basmati 1

- RP- Pusa Basmati 1
- Xa* 13 and *Xa* 21 incorporated
- Resistant against BB
- Rice



Improved Swarna

- RP- Swarna
- Sub 1* gene incorporated
- Can survive 12-14 days submergence
- Highly adopted in Eastern India



MAS Products in Maize



Vivek Hybrid - 9



QPM version of
Vivek Hybrid - 9

Vivek QPM 9

Released for Commercial
Cultivation by CVRC in 2008

Launched by the Hon'ble
Min Sci. & Tech. in Jan 08



Vivek QPM 21

Organic Conditions, Uttarakhand





Improved Samba Mahsuri

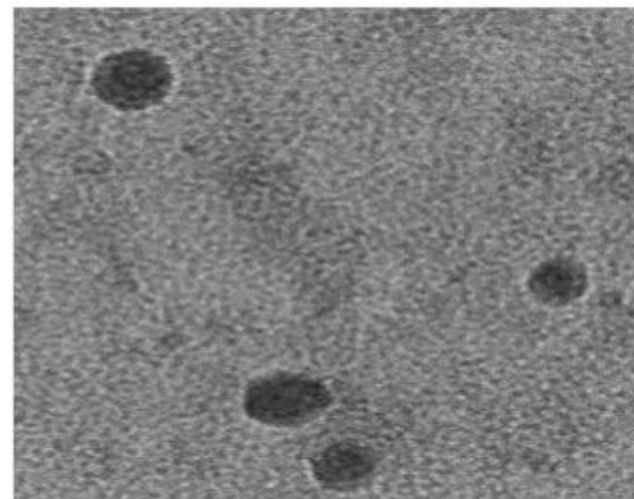
- A bacterial blight resistant derivative of Samba Mahsuri, i.e. IET19046 was developed jointly by ICAR-IIRR and CSIR-CCMB and released as **Improved Samba Mahsuri (ISM)**
- A success story of rice biotechnology in India. Excellent example of Inter-Institutional collaboration (CCMB-IIRR).
- ISM doing very well in farmers fields. ~200,000 hectares occupied by variety
- ISM licensed to two Pvt. seed companies (M/s Sri Biotech Pvt. Ltd., Hyderabad and M/s Metahelix Life Sciences Pvt. Ltd., Bangalore, each for Rs. 8 lakhs)
- Due to its low glycemic index (GI) value, lot of interest from several companies for product licensing
- CSIR – Blight out project for popularization of ISM covering ~ 10000 Samba Mahsuri farmers in AP, TS, TN, Karnataka, Chhattisgarh, UP etc.
- Awards received: CSIR-CAIRD 2013, DBT PPC Award 2015

Development of thermostable foot and mouth disease virus like particle (VLP) as diagnostic antigen and vaccine candidate

- Generated recombinant FMD virus like capsid/particle (VLP) with enhanced thermostability by site directed mutagenesis using Baculovirus expression system (BVES).
- Recombinant VLPs were found to be thermostable.
- Behaved similar to that of whole virus particle and can be a non-infectious alternative reagent to whole virus antigen in diagnostic assay.
- Dose response study in Guinea pigs is initiated to evaluate the protective immune responses in comparison to whole virus antigen.



Construct map for expressing FMDV VLP in BVES



Transmission electron microscope image of VLPs

Biodiversity & Molecular Breeding : Mangroves



“There are no useless plants” - Charaka

Open field trial of a transgenic rice plant with Superoxide dismutase gene from *Avicennia marina*



Field Trails being carried out at Kalpakkam

Genetic Shield



Prosopis juliflora has wide adaptation to water stress and drought conditions

Used as source material for drought tolerant genes



Control

36 days of water withdrawal

Preparing for adverse changes in precipitation

- Management of agricultural research witnessed a major paradigm shift in the late 1990s in response to issues emanating from the Convention on Biological Diversity (CBD) and the Agreements under the World Trade Organization (WTO).
- Provisions under the TRIPs Agreement (Agreement on Trade-Related Aspects of Intellectual Property Rights) of the WTO established enforceable universal minimum standards of protection for all major forms of intellectual property rights (IPRs), for new knowledge, skills, technologies, and products developed by individuals or institutions.



- Recognizing the importance of commercialization of innovations in partnership with industry, the ICAR has established '**Agri-Innovate India Ltd**', a corporate entity for technology commercialization and consultancy services at home and abroad.
- The ICAR considers Indian farmers as its main client and benefactor and is fully engaged with them.
- Towards this end, the **National Bioinformatics Grid** and **mobile extension services** for a comprehensive approach from '**speed-to-market**' have been put in place



The ICAR/DARE is the first ISO-9000-2008 compliant Department as designated by the Quality Management System (QMS)

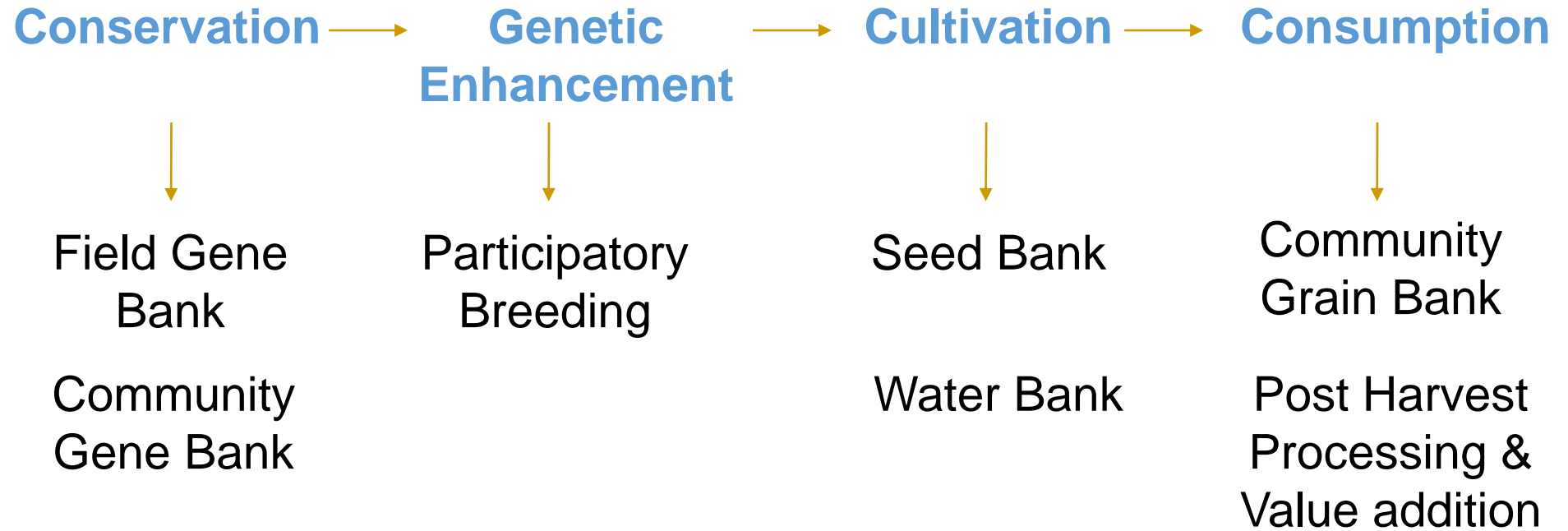


The Way Ahead

Our ability to achieve a paradigm shift from green to an ever-green revolution and our ability to face the challenges of global warming and sea level rise will depend upon our ability to harmonise organic farming and the new genetics.



Community Food, Nutrition and Water Security System



Farming Systems Diversification and Value Addition

8% growth rate in horticulture and animal husbandry will be necessary to achieve 4% growth rate in agriculture as a whole

Livestock and Livelihoods

Over 50 million women and 15 million men are involved in Dairy Enterprises in India



India: Largest Producer of Milk in the World

- Changes in livestock production, increase the potential for new pathogens to emerge, grow and spread from animals to humans on a global scale.
- Effective phytosanitary and animal health regimes, aided by new vaccines, diagnostic products and tools, and epidemiological information are necessary to survive in the emerging regulatory regime

- **A National Fund for Basic and Strategic Research** is functioning under the ICAR, with the objectives of building capacity and breaking yield and quality barriers through the partnerships of all.
- The Council is embarking on two missions, - **‘Farmer FIRST’** and **‘Student READY’**, as also the consortia platforms for bringing greater partnerships.

- Two major projects, viz. **National Agricultural Education Project** and **National Agricultural Entrepreneurship Project**, are being formulated.
- Value-addition to primary agricultural production in crop/horticulture/dairy/meat/fish, in order to make the agricultural sector competitive, is a priority.
- Mechanisms are also being developed for the Agri-Innovation fund, Agri-Incubation fund, Regional implements fabrication and processing hubs, and Referral facilities.



- Prioritization, Monitoring, and Evaluation (PME) Cell.
- Project Monitoring and Evaluation Committee (PMC)
- Institute Research Council (IRC)
- Research Advisory Committee (RAC)
- Quinquennial Review Team (QRT)



The central role of PME cells.

- Prioritization, Monitoring, and Evaluation (PME) cells have been institutionalized and operationalized in ICAR institutes with the aim to bring about the proper and judicious allocation of research resources, thereby bringing accountability, transparency, and objectivity to the system.
- PME cells fully integrate research decision-making at the institute level; wherein formulation, evaluation, and implementation of project proposals of all kinds are integrated.
- Through the single-window mechanism of PME cell, the IAs or core competencies of individual institutes are projected to the outside community, to improve the visibility of the professional strengths, contributions, and roles of each Institute.



Project Monitoring and Evaluation Committee (PMC)

- Project Monitoring and Evaluation Committee (PMC) deliberate on reports submitted by PME Cell and decide on the research priorities of the institute.
- PMC, through an expert committee constituted by it, **evaluates the yearly progress of research projects** and submits the report to PME Cell.
- PMC also **validates completed projects** through a committee of experts.



Institute Research Council (IRC)

- Institute Research Council (IRC) is attended by all the Heads of Divisions, Scientists and is Chaired by Director. Project proposals are approved in IRC.
- **Two IRC meetings are held annually to review the progress of research during the year.**



Research Advisory Committee (RAC)

- **RAC gives overall direction for research activity in the institute** and it also reviews the research progress. The recommendations of the committee are approved by the Council.
- The committee has a panel of experts drawn from different fields in which the institute undertakes research activities. The duration of the committee is for three years. The committee meets once in a year



Quinquennial Review Team (QRT)

- **This team** appointed by the Council **reviews the functioning of the institute once in five years period.** The report of the team is to be submitted within six months after the completion of the review. This is submitted by the team to the Council which is presented before the Governing Body of ICAR.
- This review provides a mechanism of transparency and accountability of the Institute to the Governing Body (GB). Recommendations by the GB are taken care of by the institute through Action Taken Report (ATR) which is reviewed during each Research Advisory Committee meeting (RAC).



Creating awareness of core competence.

- An assessment of the expertise and infrastructure available in the Institute is carried out to arrive at the specific strengths and competencies which are in demand and could be shared profitably.
- and based on the assessment, each Institute shall publish and project information on the areas of activities, within the mandate of the Institute, where there is scope for professional research and development service functions with the outside client.

- This is circulated widely through appropriate brochures/bulletins/hand-outs of high quality, press insertions, the internet, or through other media.
- This is also highlighted at all the seminars, symposia, conferences, exhibitions, Kisan Melas etc., so that the prospective clients may be adequately advised about the potential services offered and the opportunity to avail of such services.

Ethics in the Agriculture Research

Ethical considerations in all scientific pursuits remain uppermost in the professional conduct of ICAR scientists/staff.

Scientific Misconduct is the violation of the standard codes of scholarly conduct and ethical behavior in professional scientific research.

Intentional distortion of the research process by fabrication of data, text, hypothesis, or methods from another researcher's manuscript form or publication; or distortion of the research process in other ways."



Motivators of scientific misconduct

- ❖ Career Pressure
- ❖ Ease of Fabrication
- ❖ Types of research misconduct
 - ❖ Fabrication
 - ❖ Falsification
 - ❖ Plagiarism
 - ❖ Plagiarism-fabrication
 - ❖ Self-plagiarism
 - ❖ **Ghostwriting: Ghost Authors**
 - ❖ Scientific misconduct involves serious consequences, which depend on assessment, whether the misconduct is intentional or due to carelessness.

Agricultural Ethics & Sustainable Agriculture

◆ The following are some of the ethical issues related to the selection of research projects for sustainable agriculture in the world

- Technologies that damage the environment
- Consume inordinate amounts of natural resources
- Render small, family farms less able to compete in highly competitive markets
- Unduly influenced by private sponsors of research – fertilizer/pesticide/seed companies.
- Research on certain subjects, including products or services that might do harm to the environment or make food unsafe
- Research on technologies that might cause dislocation among farmers

Ethics in conduct of Agricultural research

- ❖ Starting your research
 - ❖ Selecting the topic for research
 - ❖ Designing experiments
 - ❖ Collecting and reporting data
 - ❖ Analyzing data
 - ❖ Drawing and reporting inferences
 - ❖ Establishing and maintaining credibility
 - ❖ Authorship and shared recognition
- ❖ Whistleblower
- ❖ Conflict of Interest
- ❖ IPR
 - ❖ Patent and copyright infringement
 - ❖ Trade secret infringement
 - ❖ non-disclosure agreement

Administrative Ethics & Agricultural Research

- ❖ The following are some of the ethical issues that can motivate/demotivate the available human resources and can help any organization achieve scientific excellence
 - ❖ Ethical hiring/promotion
 - ❖ Ethical nurturing of Researchers
 - ❖ Ethical evaluation of researchers' performance

It is desired that the researcher's exhibit and exercise

- 1. Scientific honesty**
- 2. Carefulness**
- 3. Intellectual freedom**
- 4. Openness**
- 5. Peer recognition**

Limitations on professional service functions for an outside client.

- All ICAR scientists/staff members' primary obligation is towards the Institute/Council to whom they belong and it is expected that s/he will not transgress the spirit on which this privilege rests.
- Further, professional service functions should not be accepted if it involves any subject or information which is prejudicial to the organizational and national interest.

Thank You