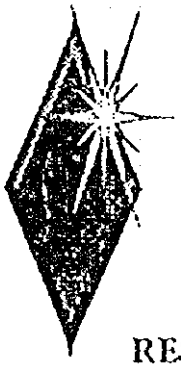


RESEARCH INSTITUTE FOR FOOD CROP BIOTECHNOLOGY (RIFCB)

Djoko S.Damardjati

CENTRAL RESEARCH INSTITUTE FOR FOOD CROPS
INDONESIA

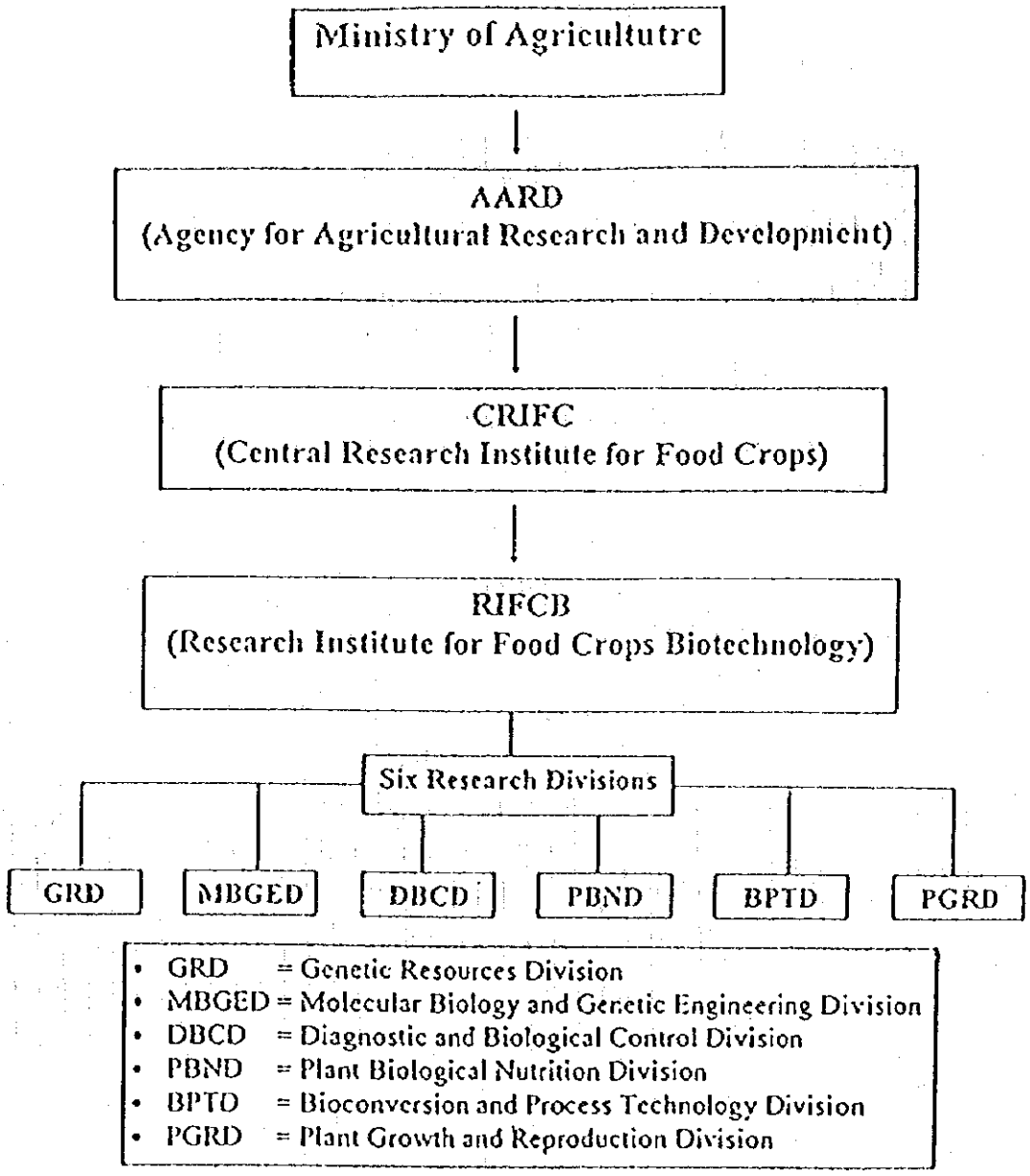
AGRICULTURAL DEVELOPMENT PROGRAM

- Maintaining self sufficiency
- Improving people's nutritional quality
- Challenge on Sustainability Agric. Development :
  - Improve productivity
  - Provide better raw material for industry
  - high population growth
  - reduction fertile agricultural area
  - outbreak of insect pest and disease
  - natural disaster, e.i.flood and drought

- Biotechnology: :
  new avenue to the solution of agricultural Problem ???

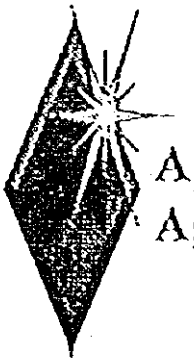
RATIONALE

- Set-up the Priorities of Biotechnology Research to support National Development Program
- Establisliment of three Biotech. Networking Center
  - Agriculture
  - Industry
  - Medicine and Health
- National Committee of Biotechnology recommended the highest priority for agric. Biotech. Research:
  - Food crop : rice, soybean
  - Estate crop: oilpalm, rubber
  - Horticulture: potato, garlic,banana
  - Animal rius.: dairy cattle
  - Vetinary : mouth disease


Ministry of Agricultutre
AARD
(Agency for Agricultural Research and Development)
CRIFC
(Central Research Institute for Food Crops)
RIFCB
(Research Institute for Food Crops Biotechnology)
Six Research Divisions
GRD
MBGED
DBCD
PBND
BPTD
PGRD
• GRD = Genetic Resources Division
• MBGED = Molecular Biology and Genetic Engineering Division
• DBCD = Diagnostic and Biological Control Division
• PBND = Plant Biological Nutrition Division
• BPTD = Bioconversion and Process Technology Division
• PGRD = Plant Growth and Reproduction Division

Current Status of Agric. Biotechnology

- *Food Crops*
  - rice, peanut, corn, sweet potato
  - microbial pesticide,-fertilizer, -conversion
- *Horticulture crops*
  - Vegetable crops : pepper, potato, Alliums,
  - Fruit crops : Mango, citrus and mangosteen
  - Ornamentals : orchids, roses, gladioli, chrysan
- *Estate Crops*
  - Oil palm, rubber, coffee, cocoa and tea
  - cloning and tissue culture
  - Biopulping , biofertilizer and biopesticides
- *Industrial Crops*
  - Tissue culture for plant propagation
- *Livestock's*
  - microbial fermentation in the rumen
  - Super ovulation (FISH or PMSG)
  - Molecular, Celluler biology and Diagnostics
- *Fisheries*
  - antibodies for vaccine (HYDROVET)
  - Diagnostics and molecular genetics



Application of Biotechnology for Agriculture

- *Tissue culture technique*
  (micro-propagation and production of disease materials)
- *Microbes to increase productivity*
  biopestices, (fungal disease control, mycoherbicides, biocontrol insects).
  biofertilizer (nitrogen fixers, plant growth proting microbes)
- *Diagnostics*
  (animal and plant diseases diagnostics)
- *Embryo Transfer in animals*
- *Recombinant Technology*
  (genetic engineering, Molecular markers)
- *Germplasm and Enhancement*
  (inventory, conservation and evaluation)

ORGANIZATION OF RIFCB

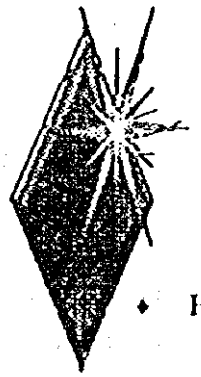
- Consist 6 Research Division
  - Genetics Resources and Germplasm
  - Plant Molecular Biology and Genetic Engineering
  - Diagnostics and Biopesticides
  - Plant Development and Reproduction
  - Biological fertilizer and Nutrition
  - Bioconversion and Bioprocess
- Has 3 supporting Section
  - Administration
  - Planning and Collaborative
  - Building and Facilities
- Other Supporting Activities
  - Manpower development
  - IPR and Patent Service
  - Analytical Service
  - Publication and Information

RESEARCH PROGRAM IN RIFCB (1)

- *Genetic Resources*
  - Exploration. Collection, conservation, evaluation
  - documentation of genetics resources
  - Improvement of genetic variation
- *Biology molecular and Genetic Engineering*
  - Mol.mark for resistance of blast diseases and Genetic variation analysis for blast pathogen (ARBN)
  - Mol.mark for drought tolerant of rice (Rockefeller)
  - Pod borer resistance of soybean
  - Cylas resistance for sweet potato (ABSP)
  - Corn borer resistance for maize (ABSP).
- *Plant Development and Reproduction*
  - Tissue culture and transformation Bt gene on soybean
  - Somaclonal propagation of Cashew
  - Somaclonal variation to increase genetic variability of vanilla and ginger
  - Ginger seed production by micro-propagation

RESEARCH PROGRAM OF RIFCB (2)

- *Biological fertilizer and Nutrition*
  - "Scale-up" production of multi-microbes fertilizer RHIZO-PLUS (Generation I) (RUK)
  - Development of Encapsulated Rhizo-plus (Generation II) (RUT)
  - Genetic engineered of fertilizer microbes (Generation III)
  - Development formula of "BIO-FOSFAT", contain P-dissolved microbes
- *Diagnostics and Biopesticide*
  - Production NPV for Spodoptera of soybean
  - Bt for corn borer and soybean podborer
  - Insect pathogenic nematodes for white stemborer
  - Peanut strip virus resistance (ACIAR)
  - Detection of pathogenic viruses and bacteria using ELISA and nucleic acid hybridization
- *Bioconversion and Bioprocesss*
  - Lignoceluletic for waste bioconversion
  - Bioprocess for inactivation of lipase and reduction of phytate on rice bran
  - Production of amylase for indigenous raw material and products



PATENT FROM RIFCB

- Has been Patented :
  - Microbial Fertilizer : *Rhizo-plus*
    - for soybean in up-land and low-land
    - Patent No. P. 890099
    - Date : January 15, 1996
  - Microbial Fertilizer : *Bio-Fosfat*
    - Multi-purpose for increase absorption Phasphate fertilizer
    - Patent No. P. 980100
    - Date : January 15, 1996
- processed to propose in 1996-1997 :
  - Bio-pesticide : SNV for soybean spodoptera
  - Bio-pesticide : Bt for corn borer
  - Bio-pesticide : Bt for soybean pod-borer
  - Bio-conversion : Lignosellulotic microbes for composting
  - Bio-fertilizer : Encapsulated Rhizo-plus

PROJECT DESCRIPTION

RICE : - Stress tolerance (drough)
- Disease resistance (Blas&BLB)
- Insect resistance (RSB)

SOYBEAN: - Insect resistance (Pod borrer)
- Microbial fertilizer (Rhizobium)
- Bio-pesticide (cut-worm)
- Genom Mapping
- Protein quality
- Biological control

MAIZE - Insect resistance (stem borrer)

S.POTATO: - Insect resistance (cylas R.)
- Starch improvement

GINGER , PEPPER & VANILLY
- plant reproduction
- quality

ENVIRONMENT:
- Composting process
- L'gnocellulatic enzymes

FOOD PROCESS
- Lipase reduction
- endogenous amylase

Summary of Evaluation of Biotechnology Group Under ARMP I

SAR TARGET	Actual Achevied	Remark
I. Consultancy		
1. Genetic conservation and germplasm center	Research program for genetic conservation and strategy for germ plasm center improvement	good
2. Program Evaluation and work plan development of 5 year activities	Expected achievement : Development research program for 5 years	
II. Biosafety		
A. Biosafety containment		
1. Building	Design	
2. Regulation	Containment regulation draft	
3. Regulation for containment	Biosafety containment type that suitable for Indonesian condition	
B. Biosafety regulation	Biosafety regulation draft	good
C. Training Moleculer Biology and chemical analysis methods	Improvement methods of molecular biology and chenical analysis on biotechnology research activities	good
III. Training		
A. Short-term group training		
1. Application Biotechnology 2. Laboratory management	Improving capability of researcher on application biotechnology and laboratory management.	good
B. Scientific exchange		
1. Industrial and Agricultural Biotechnology 2. Agricultural Biotechnology	Improving capability of research activities on industrial and agricultural biotechnology and agricultural biotechnology	good
C. Short-term individual training		
1. Molecular marker in breeding 2. cDNA cloning on Soybean	Improving Research Capability on molecular marker and cDNA cloning	good

SAR TARGET	Actual Achevied	Remark
IV. Intelectual Property Right (IPR)		
1. Application of IPR for RIFCB product	Patent for Rhizoplus and Biophosphate	
2. Improvement molecular biology activities	- Molecular biology laboratory and equipment - Design of Biosafety containtment - DNA-recombinant and other equipment	good

Q1 *How the quality and relevance of research improved due to ARMP I*
By improving researcher capability, laboratory facilities, discussion with consultant and budget avialability

Q2 *Detailed about major research activities supported under ARMP I*

Objective of activities	Research done	Result
1. Title: Soybean variety improvement Objective : to identify of desirable gene resources	1992/1993	45 promising line consist of: - 11 genotipes tolerance to drough - 10 genotipes adapted on acid soil - 18 genotipes suitable for intercrop with corn
2. Title: Improvement of soybean seeds quality base on physical, processing and method of simple storage Objective : to produce a good quality of soybean seeds	1992/1993	Good soybean seed quality can be produced by. - planting soybean on mountain area (high land) - Applicating Ethilene and Cytohinin on soybean in the field - Drying of soybean seed using bamboo mat
3. Title: Characterization of soybean to drought, soil and crop management to alliviate drought problem under rainfed lowland and upland condition Objective : to indentify physiological character of soybean under drought stress	1992/1993	- Malabar variety and Lamp 1248-4-4 are tolerant to drought - Used Mo on grummosol to alliviate drought problem
4. Title: Identification factors affecting yield gap of soybean in Cianjur (West Java) Objective : to identify biotic and abiotic factors affecting yield gap of soybean in Cianjur	1992/1993	- Soybean yield gap at Cianjur caused by seed quality, lack of pest management practices and planting local variety.
5. Title: Characterization and evaluation of pest resistance, cultural technique, phisiological characteristic of soybean germ plasm Objective : to find gen source that resistance to pest	1993/1994	- 2 mungbean lines were resistance to powdery mildew - 2 mungbean lines were early maturing varieties

Objective of activities	Research done	Result
6. Title: Development of base population for high yielding variety of food crops Objective : -to screen local variety as parent stock -to develop gene pool of corn	1993/1994	– 7 rice varieties have good milling quality – 5 soybean and corn varieties have good seed for parental stock – 48 rice lines were resistant to BPH and BLB
7. Title: Study on plant secondary component which toxic to plant pest Objective : to evaluate plant secondary product which toxic to main pest.	1993/1994	– Extract from 3 plant species were toxic to BPH – Extract from 2 plant species were toxic to larvae of army worm and pod borer
8. Title: Phisiological aspect based on utilization of biofertilizer and phytohormone on food crops Objective : to evaluate at utilization of the natural resources as source of phytohormon and soil conditioner	1993/1994	– Soil condition can be improved by applicating carbonized rice husk – Coconut water increased the presentage of seed germination and the vigor
9. Title: The use of potential natural enemies in controlling pests and disease on food crops Objective : to get data and an information the effectiveness of natural enemies in controlling pest and diseases on food crops	1993/1994	– Combination of 6 spiders and mirids were effective to control BPH population – Trichoderma spp. were effective to control B. solani
10. Title: Biological weed control and impact of weed control on environment Objective: to get data and an information the effectiveness of natural enemies in controlling weeds on food crops.	1993/1994	Holtica cyanea was effective to control Justeae repens and J.linifolea
11. Title: Agronomic characteristics evaluation of some irrigated lowland rice lines with good grain quality Objective: to evaluate agronomic characteristics for improving rice plant	1994/1995	Yield of B777b-MR-8-1-1, B7959f-Kn-14-2 and B7812f-MR-58-5-3 higher than IR64. Sanitation of damage root, inrechcides application.

Objective of activities	Research done	Result
12. Title: Integrated pest management of sweet potato weevil, *Cylas formicarius* fabricius on high yielding sweet potato varieties Objective : to establish data on the rate of effectiveness of some cultural techniques and pest management tacties to sweet potato weevil infestation	1994/1995	Sanitation of damage root, insecticides application, mulching and hilling up at 8 and 11 wrt reduced yield loses caused by weevil
13. Title: Basic of pest control and phisico-chemical characteristics of food crops Objective : the relationship of chitinase production in some isolates of *B.bassiana* and *M.anisophase* and their virulence to C.formicarius. To find and mode of inheritance and hervability of resistance to leaf spots diseases (Cercospora sp.) on mungbean.	1994/1995	Virulence isolates of *B.bassiana* and *M.anisophase* have high activities of chitinase - Resistance to leaf spot was control by one or two genes.
14. Title: Analysis of abiotic components on some legumes inter cropping system in upland areas Objective : to find the variety which is efficient on P nutrient absorption	1994/1995	P nutrient uptake of Malabar soybean varieties and Kelinci peanut varieties more efficient than another soybean and peanut varieties
15. Title: Molecular Mope and markers to tag of blast and BLB resistance characteristics on upland rice		- Marker for blast disease - gene maping
16. Title: Development of scale up production system on microbial fertilizer Rhizo-plus for soybean		Mass production technique for Rhizo-plus.

Biotechnology Research Proposals

Found Source : ARMP II

No.	Research Tittles/activities
1.	Engineering transgenic corn resistant to asian stem borrer 1.1. To establish method of embryo culture and regeneration 1.2. To isolate gen *cry* 1.3. Optiminizing transformation system for gen trancient 1.4. Cloning and construction of gen cry 1.5. Construction and expression of gen cry in microbial system 1.6. Gen cry product bioassay to Asian steemborer 1.7. Gen cry sequencing 1.8. Gen cry syntezing and optimizing of gen cry 1.9. Construction and expression of gen cry in plant system 1.10. Plant transformation
2.	Genetic engineering of Sweet Potato (*Ipomoea batatas* (L.) Lam) Resistance to *Cylas formicarius* 2.1. Optimizing regeneration system for sweet potato (1996-1997) 2.2. Cloning and constructing protease inhibitor (pin II) gene (1996-1997) 2.3. Preliminary study on sweet potato transformation using either a biolistic or *Agrobacterium tumefaciens* (1997-1998). 2.4. Killed curve study (1997-1998) 2.5. Bioassay test for the effectiveness of pin II on *Cylas formicarius* (1997-1998). 2.6. Optimising transformation system using either a biolistic or *Agrobacterium tumefaciens* (1998-1999) 2.7. *In vitro* insect bioassay of transgenic callus of sweet potato (1998-1999) 2.8. Molecular analysis of transgenic sweet potato resistance to *cylas formicarius* (1999-2000) 2.9. Insect bioassay of transgenic sweet potato (1999-2000) 2.10. Field testing of transgenic sweet potato (2000-2001)

3.	Decomposition of agriculture waste for organic fertilizer 3.1. Evaluation of microbes having capability of composting and antagonisticto soil borne diseases 3.2. Formulation of the besat combination of microbes for rapid decomposition 3.3. Formulation of plant waste for organic fertilizer production
4.	Identification and characterization of some *Azospirillum* spp. muntants and some potential plants that have capability to produce growth hormone in culture 4.1. IAA 4.1.1. Mutagenesis of *Azospirillum* 4.1.2. IAA determination 4.2. Cytokinins 4.2.1. Screening of plants which naturally produce cytokinins 4.2.2. Plant propagation 4.2.3. Extraction and purification
5.	Geenetic engineering of soybean for resistance to rust fungus (*Phakopsora pachyrhizi* Syd.) 5.1. Enzyme isolation of chitinase from antagonistic microbes 5.2. Chitinase application for rust control
6.	Establising a quality system in laboratory according to ISO-guide No.25, and obtaining an ISO9000 certificate from National Association for Testing Authorities, Australia (NATA) 6.1. Improvement of all management and operation according to ISO-guide No.25 6.2. Invite external auditor 6.3. Adjustment/improvement according to Auditor recommendation/suggestion 6.4. Application for NATA accreditation 6.5. Prosess of NATA accreditation

7.	Varietal improvement of rice through anther culture 7.1. Hybridization 7.2. Introduction and plant regeneration 7.3. Screening for haploid plants 7.4. Chromosome doubling and selection for double haploid plants
8.	Cloning gen cellobiohydrolase (CBH) of *T. Koningii* to increase its activity in degradation of agricultural waste 8.1. Characterization of cellobiohydrolase 8.2. Selection of *T.koningii* 8.3. Gene transformation 8.4. DNA-recombinant transformation
9.	Genetic characterization by isoenzymes and DNA markers and in vitro selection for the resistance to stem rot disease in vanilla 9.1. Genetic analysis by isoenzymes and DNA marker *9.2.* Cell regeneration and in vitro selection for the resistance to *fusarium oxysporium*

RESEARCH INSTITUTE FOR LEGUME AND TUBER CROPS (RILET)

Since in the longterm development I (PJP I) programmes, Indonesia has successfully achieved rice self-sufficiency (1984), in the PJP II, therefore, the Government of Indonesia promoted improvement of farmers' prosperity through increasing their income with an agribusiness approach.

In the future years, legumes and tuber crops will be the important and prospective cash-commodities for food diversification. Therefore, a research institute for legumes and tuber crops is extremely needed. Based on the degree of the Ministry of Agriculture No: 796/Kpts/OT 210/12/94 on 13 December 1994, a new research institute on legumes and tuber crops was established, the so-called RESEARCH INSTITUTE FOR LEGUME AND TUBER CROPS (or RILET). RILET is a new name of the previous institute, MARIF (Malang Research Institute for Food Crops).

MANDATE

As the National Institute for legumes and tuber crops, RILET has the mandates on :

- Breeding, agronomic and physiology, cultural techniques, crop protection, agroecosystem and agroeconomic, post harvest technology and mechanization, environment aspects, cropping system and commodity analysis of legumes and tuber crops.
- Technology component for legume and tuber crops farming system.
- Exploration, evaluation, maintenance and utilization of legumes and tuber crops germplasms.
- Technical-assistance service, research collaboration and dissemination of research results.

ORGANIZATION

RILET is one of the six research institutes for food crops coordinated by the Central Research Institute for Food Crops (CRIFC) in Bogor. All agricultural researches within the Ministry of Agriculture in Indonesia are under the direction of the Agency for Agricultural Research and Development (AARD), Ministry of Agriculture.

In the daily operation, Director of RILET is assisted by the head of Administrative section (consisted of Administrative and Finance subsections), Technical Services (consisted of Laboratory and Fields facilities sub-section) and Work planning section (consisted of Collaborative-research and Information services sub- section).

Researchers and research assistants are grouped into 5 (five) research disciplines, namely:

1. Research group for Plant Breeding and Genetics : focuses on exploration, evaluation, maintenance and utilization of legumes and tuber crops germplasm for breeding.
2. Research group for Physiology, Agronomy and Agroecology : pays attention on research for physiological and agronomic aspects, cultural practices and agroecosystem and environments analysis.
3. Research group for Entomology and Phytopathology: searches on bioecology, epidemiology, biological control and IPM (Integreted Pest Management) for main pests and diseases of legumes and tuber crops.
4. Research group for Post Harvest and Mechanization : decides post harvest technology and development of machinery for legumes and tuber crops.
5. Research group for Agro- economic : finds out the agroeconomic aspect of production technology, commodity and farming system analysis.

STAFFING

RILET employs 258 staffs, consisting of 95 researchers, 8 of which carried their Doctors (PhD's), 37 Masters (MSc), 47 Engineers (Ir) and 113 field assistants (94 senior and 19 junior high school levels). At present there are still

another 92 temporary staff with different educations levels. Most of the research-staff members have attended trainings, seminars or symposium either in Indonesia or abroad.

RESEARCH FACILITIES

To support research activities, at present RILET is facilitated with 6 Laboratories, 7 greenhouse compartements, 2 cold stored units and 1 workshop. The six laboratories carries their functions as for:

- Plant Breeding
- Agronomy
- Soil & Plant analysis
- Phytopathology (Mycology, Bacteriology, Virology, Nematology)
- Entomology
- Food technology and Chemical service
- Mechanization

Cold storage facilities (1 unit chiller and 1 unit freezer) are used to store legumes germplasm collections. Cassava and sweet potato germplasm are maintained as the living collections . Today, the numbers of collections found at RILET. consists of:

- Soybean : 901 accessions.
- Groundnut : 228 accessions.
- Mungbean : 1002 accessions.
- Cowpea : 40 accessions.
- Pigeon pea : 55 accessions.
- Cassava : 232 clones.
- Sweetpotato : 325 clones.

RILET has also 5 experimental fields called Research Installation for Legumes and Tuber Crops, located in East Java namely : Kendalpayak and

Jambegede (Malang), Muneng (Probolinggo), Ngale (Ngawi) and Genteng (Banyuwangi).

To improve the researchers knowledge on the latest information of agricultural researches and methods , RILET is facilitated with a Library unit. At present more than 6,230 texbooks, 82 International journals, and 112 Indonesian Journal and thesis are documented in the library.

COOPERATION WITH OTHER ORGANIZATIONS

RILET maintains collaborative research programmes with several national and international institutes and organizations engaged in research for legumes and tuber crops, including participation in international multi-location trial programmes.

At present RILET is cooperating with the following institutes with programmes

- ICRISAT (International Crops Research Institute for Semi Arid Tropics) in India : research on groundnut and pigeon pea.
- AVRDC (Asian Vegetable Research and Development Centre) in Taiwan: exchange of soybean germplasm.
- CIAT (Centro Internacional de Agricultura Tropical) in Columbia: exchange of root crops germplasm.
- IITA (International Institute for Tropical Agriculture) in Nigeria: exchange of cowpea germplasm.
- JIRCAS (Japan International Research Centre for Agriculture Science) in Japan: research on breeding resistance of soybean and nematology.
- ACIAR (Australia Centre Institute for Agriculture Research) in Australia : research on groundnut

As well, RILET makes a good cooperation with several national research institutes, universities and private sectors.

RESEARCH PROGRAMS

Research programmes at RILET based on the AARD and CRIFC programmes, national issues and the existed problems. These researches are directed to :

1. Varietal improvement : high yield, short duration, resistance to biotic/ abiotic stress, respons and efficiency in nutrient use, and a good quality.

2. Innovations on production and post harvest technology of legumes and tuber crops in order to increase efficiency and economic values of products.

3. Increasing stability and sustainability in legumes and tuber crops production system to support the National food self-sufficient.

4. Basic-oriented research on efficient use of agriculture energy input, and natural resources.

Research programmes are appointed based on the commodities approach which is supported by inter-disciplines programmes.

RESEARCH RESULTS

MARIF (Malang Research Institute for Food Crops), the previous Institute had released three improved varieties of maize namely: **Rama, Hybrid Semar-1** and Semar-2, four soybean improved varieties: **Jaya Wijaya, Krakatau, Cikurai,** and **Dieng;** one groundnut variety Zebra, one mungbean variety Sriti and three cowpea varieties: KT-I, KT-II and KT-IV.

Two improved cassava cultivars: **Malang-1** and **Malang-2** and one sweet-potato cultivar, **Mendut** were also released.

RILET also produced maize thresher, **Ramapil** and **Senapil**, which had several advantages such easy to assemble and as well as had high capacity.

RESEARCH COMMUNICATIONS AND PUBLICATIONS

Research results of RILET are disseminated and communicated with the user (researchers, extention and agricultural services, policy makers and farmers) through the field days, seminars, symposiums or exposure on newspaper, radio and televisions programmes.

A number of publications in form of journal, monograph, and proceeding of the seminars/symposiums have been published by ex MARIF (RILET).

(1) Journal Penelitian Palawija

(2) Monographs :

- No. 1. The Home Gardens of East Java (Results of an agro-economic survey)
- No. 2. Palawija, Food Crops other than Rice in East Java Agriculture
- No. 3. Maize On-Farm Research in the District of Malang (English)
- No. 4. Pigeon pea (Indonesian)
- No. 5. Sorghum (Indonesian)
- No. 6. Maize Thresher Type F11.223 (Indonesian)
- No. 7. Pesticides Management in Integrated Pest Managemant of Soybean Pest. (with English summary)
- No. 8. Peanut Stripe Virus and Its Management (Indonesian)
- No. 9. Mungbean (Indonesian)
- No. 10. Study on the New Production Growth of Soybean in NTB (Indonesian)
  No. 11. Study on the New Production Growth of Rice in NTB (Indonesian)
- No. 12. Groundnut (Indonesian)
- No. 13. Identification of pest and diseases on maize an their control (Indonesian)
- No. 14. Upland rice (Indonesian)

(3) Proceedings of Seminars/Symposiums and Workshops

- Proceeding of Research Result on Land Productivity Management after Kelud Volcano Erruption (Indonesian)
- Proceeding of Workshop on Integrated Pest Management of Soybean (Indonesian)
- Proceeding of Farming System Research Result Seminar in NTB (Indonesian)
- Proceeding of Workshop on Hybrid Maize Seed Production (Indonesian)
- Proceeding of Seminar on Groundnut Research Result at Tuban District (Indonesian)
- Proceeding of Seminar Food Crops Research Results (1989, 1990, 1991, 1992, 1993, 1994)(with English abstract)

(4) Special Edition of MARIF/RILET

- Discription of Legumes Cultivar (Indonesian)
- Research of Fertilization and Lowland Rice Varieties, to support Rice Selfsufficiency (Indonesian)
- Grain Legumes Breeding (English)
- Research Highlight of MARIF on 1985 - 1989 (Indonesian)
- Supporting Research for Increasing Food Crop Production (Indonesian)
- Improvement of Groundnut Technology Component (Indonesian)
- Development of Technology for Root Crops Production in Indonesia (English)
- Development of Cultural Technology for Food Crops at Vertisol Soil (Indonesian)
- Proceeding of Seminar for Applied Sweet Potato Production and Post Harvest Technologies to Support Agro-Industry (Indonesian)
- On-Farm Research on Groundnut and Pigeonpea Production Technique in Indonesia (English)

RILET

Research Institute for Legume and Tuber Crops

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