

Project Proposals for the RCA Programme 2020/2021 2nd Round Project Concept Template

Part 1: Information Sheet

Project proposals for the RCA Programme 2020/2021 are to be prepared using the attached template. Completed templates will be reviewed by the RCA PAC at the Meeting in Vienna being held 28 January to 2 February 2018.

- **PLEASE NOTE THAT ALL PROSPECTIVE CONCEPTS REQUIRE INFORMATION THAT IS LODGED ON THE RCARO WEBSITE (access is only required to the RCA information not the whole Members Only site).**
- **YOU WILL HAVE TO APPLY FOR A PASSWORD AND ACCESS CODE TO ENABLE ACCESS TO THIS INFORMATION.**
- **PLEASE GET ENDORSEMENT FROM YOUR NATIONAL REPRESENTATIVE FOR THIS ACCESS.**

The 2nd Round Concept Proposals will be evaluated against the response to the feedback you have received from RCA PAC on your 1st Round Concept Proposals as well as the criteria listed below:

- **Is its aims and objectives in line with priorities set out the RCA Medium Term Strategy for 2018/2023?**
- **Identify which elements of the MTS are being complied with.**
- **Why it should be a regional project.**
- **The essential role of the nuclear technology in the project.**
- **Does the proposal identify links to previous projects in this area of technology?**
- **Does the proposal overlap or duplicate current or previous RCA projects?**
- **Is a convincing case made to justify further projects in this area?**
- **Is there a strong TCDC component to exploit the benefits from the earlier projects?**
- **Is there a readily available baseline against which to measure the effectiveness of the project?**
- **If the proposal is essentially an extension of previous projects in this area that have been implemented for more than 2 TC Cycles, does the proposal include arrangements for the transfer of project leadership to others?**

In addition to the above, please address the following specific questions:

Was this concept identified at the 46th RCA GCM as requiring merger with other similar concepts?	NO
If “YES” – was this concept prepared as a result of consultation with the other proposers?	
If “NO” - why was this not undertaken?	There was no any other similar concept identified at the 46 th RCA GCM. The proposed is a novel concept project different from the previous ones.

(Please note that it is important to address all the dot points in the Concept Template.)

Your National Representative will be reviewing the concept document to ensure that it has been prepared in compliance with the RCA special requirements.

(Please be aware that, if your concept design does not take account of the special requirements for the RCA programme, it will be rejected.)

Part 2: Concept Template

Title:

- *The title should be as concise as possible and should summarize the objective of the project.*

Mutation by Speed breeding for sustainable enhancement of crop productivity and quality in Asia and Pacific Region

Compliance with the RCA Medium Term Strategy for 2018/2023:

All RCA projects have to comply with the RCA MTS for 2018/2023 - please refer to the MTS document.

- *Briefly indicate to which specific MTS priorities this project proposal contributes.*

This proposal is right in line with the RCA MTS for 2018-2023 priorities in Food and Agriculture, i.e., “Increase agricultural production, productivity and quality of plant and animal commodities through sustainable use of available resources”.

- *How will these be achieved?*

The proposed project will integrate induced mutations with rapid generation advance approaches for sustainable promotion of crop productivity and quality through development and dissemination of new mutant cultivars with high yield and good quality, to finally achieve the above specific MTS priorities.

Overall Objective:

- *State the objective to which the project will contribute. (Note this has to be in line with the RCA MTS for 2018/2023. It should be a short description expressed as: To do)*

To establish a new methodology of Mutation by Speed breeding (MbyS) for sustainable enhancement of the production of crop yield and quality in selected crops in the Asia and Pacific Region.

Proposed Participating Government Parties:

- *List the Government Parties expected to participate in the project.*

China, Australia, Bangladesh, Cambodia, India, Indonesia, Japan, Korea, Laos, Malaysia, Mongolia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam

- *Indicate each of those where you have baseline information on their requirements and needs:*

The expected advanced partners:

China: novel mutation techniques—heavy ion beams and space flight and doubled haploids

Australia: molecular mutagenesis and marker-assisted selection for nutrient and stress

India: irradiation facility and screening techniques for sprouting tolerance

Indonesia: irradiation facility and screening techniques for drought tolerance

Japan: novel mutation techniques—heavy ion beams and near-infrared screening

Korea: novel mutation techniques—proton beams and screening techniques for salt tolerance

Malaysia: novel mutation techniques—gamma greenhouse irradiation for vegetatively propagated crops

Vietnam: irradiation facility and screening techniques for drought tolerance

Bangladesh : irradiation facility and doubled haploids

The expected less advanced partners:

Cambodia: establishment and expertise

Laos: establishment and expertise

Pakistan: speed breeding

Thailand: speed breeding
Philippines: speed breeding
Mongolia: facility and techniques
Nepal: facility and techniques
Myanmar: facility and techniques
Sri Lanka: facility and expertise

Technical Cooperation among Developing Countries (TCDC) Project Component:

Review the documentation on line – www.rcaro.org/ ???.

- *Outline the TCDC strategies to be used in the project to enhance regional cooperation:*

The project will provide technical cooperation on mutation and speed breeding approaches among the Asia and Pacific region GPs through a series of TCDC activities, and enhance regional and national capacities on improving crops productivities. The expected TCDC strategies including:

- ✧ Sharing irradiation facilities: partners with heavy ion beam or other irradiation facilities (China and Japan) will provide mutation opportunities to other partners especially those less advanced according to their requests.
- ✧ Sharing mutant germplasm, biotechnologies and expertise: mutant germplasm exchange between GPs, techniques and technical experiences on molecular mutagenesis and speed breeding techniques from high and intermediate level partners will be shared with other GPs, and help them utilize the MbyS methodology through scientific visit or expert mission.
- ✧ Training human resources: regional training course on specific topics on MbyS methodology will be discussed and designed based on the requirements of participating partners, and young scientist could be trained through these training courses.

- *Will the project design feature partnering arrangements between those advanced and those less advanced in the technology?*

The project will design feature partnering arrangements based on the facility resources, expertise, and requirements of partners.

- *If so, list those expected partnerships.*
 - ✧ China, Japan — Mongolia, Bangladesh, Pakistan: ion beam irradiation mutation techniques and/or doubled haploids protocols
 - ✧ Australia — Malaysia, Philippines, Thailand: molecular mutagenesis and marker-assisted selection
 - ✧ India, Indonesia, Korea, Vietnam — Myanmar, Cambodia, Sri Lanka: cost-effective and advanced biotic/abiotic screening techniques
 - ✧ Other potential partnership from the requests of GPs.

Analysis of gaps / problems / needs as applied to the RCA region:

- *Outline the major gaps / problems/specific needs to be addressed by the project (~ 300 words):*

The population in Asia and the Pacific Region will reach to 4.9 billion by 2030, which accounts for nearly half of the world's population. Asia, which produces 90% of the world's rice, has seen yields stagnate in recent years due to rising temperatures bringing diseases and pests, extreme floods and droughts, and a rise in sea levels that leads to increased soil salinity in coastal areas. Climate change is increasingly and adversely impacting food security and agricultural production and productivity, particularly in Asia. Meeting the future basic demand for main agricultural products in this region will ultimately depend on sustainable development of new crop cultivars adapted to ever-changing environments. However, the breeding of new cultivars takes dozens of years, annual breeding cycle restricts the ability of crop breeding to meet these demands, which often limited to only 1-2 generations per year, but 4-6 or even more generations are essential to develop genetically stable lines.

Mutation induction techniques could increase genetic diversity and provide mutant germplasm with desired phenotypes, which could be used in breeding and research process. The new and improved development of molecular biotechnology and phenotyping methodology make it available to develop new cultivars with improved mutant traits in a short period. Nowadays, there are three ways for speeding up the breeding generation cycle. Increased selection efficiency and accurate marker assisted selection (MAS) result in much shorter time to obtain desirable genotypes; Speeding up homozygous process can be approached by one-step pure breeding such as double haploid (DH) process or by MAS for homozygous individuals to reduce the time required to reach breeding-true; Promoted growth and development to manage more generations per year through mini-mutants, early mutants, greenhouse, growth chamber etc. Newly developed speed breeding methods may achieve up to 4-6 generations per year for selected crops in fully controlled growth chambers, and accelerate crop development for research purposes including phenotyping of adult plant traits. Modern phenomics and high-throughput automated systems like near-infrared reflectance spectroscopy, CropVIEW, Crop 3D etc. have provided efficient tools and approaches for phenotyping agronomic traits. However, these speed breeding and high-throughput phenotyping methods have not yet been widely used in the developing countries in the Asia-Pacific region, it is necessary to enhance technical cooperation among member states through research collaboration and training to share knowledge, protocols and methods on mutation by speed breeding.

- *Review the resource documentation and list any past RCA projects that have addressed similar problems/needs in this area of technology.*

Five RCA projects in mutation breeding field have been carried out since 2003, and their objectives were designed to establish mutant exchange network, develop mutant germplasm, exploit new mutagenesis, and apply these resources in crop improvements, rather than address rapid generation advanced methodology for both mutant identification and utilization.

The newly proposed concept project is going to develop a new methodology to accelerate mutation breeding process, and the overall objective is distinguished with the last five projects, i.e., to establish a new method to integrate induced mutagenesis and novel phenotyping approaches to accelerate the wide application of mutation breeding. In addition, to function the mechanism of sharing of GP' expertise, technology, resources, facilities and other capacities with one another.

The following is the list of past RCA projects:

- ✧ RAS/5/040: Enhancement of Genetic Diversity in Food, Pulses, and Oil Crops and Establishment of Mutant Germplasm Network, 2003-2006. *It's objective was to develop mutant germplasm in crops.*
- ✧ RAS/5/045: Improvement of Crop Quality and Stress Tolerance for Sustainable Crop Production Using Mutation Techniques and Biotechnology, 2007-2011. *It's objective was to develop and transfer methodologies and technologies for the induction and identification of mutated genes contributing to important crop quality characters and stress tolerance to RCA Member States.*
- ✧ RAS/5/056: Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change, 2012-2015. *It's objective was to exploit and utilize new mutagenesis approaches.*
- ✧ RAS/5/070: Developing Bioenergy Crops to Optimize Marginal Land Productivity through Mutation Breeding and Related Techniques (RCA), 2015-2018. *It's objective is to increase productivity of marginal land through improvement of bioenergy crop by mutation and related techniques.*
- ✧ RAS/5/077: Promoting the Application of Mutation Techniques and Related Biotechnologies for the Development of Green Crop Varieties (RCA), 2017-2020. *It's objective is to develop new varieties with improved green traits.*
- *What are the major additional capabilities/skills in this area of technology that will be provided through this project (~ 200 words).*

The major capabilities/skills provided through this project including:

- ✧ Speed breeding methodologies on double haploid approach, marker assisted selection (MAS) and speeding up growth in controlled environment on crops would be shared within the counterpart institutions through training courses, such as protocols of double haploid process, molecular markers and their detection methods; specific advices on management of controlled crop growth chamber can be provided through expert missions.
- ✧ High-throughput phenotyping methodologies could be provided, and researchers from member states could learn these techniques through regional training courses, like using near-infrared reflectance spectroscopy to detect crop quality, using software to analyse thousand grain weight, using CropVIEW or Crop 3D to characterize physiological and biochemical properties.
- ✧ Novel mutation techniques including effective use of traditional nuclear irradiation and advanced mutagenesis could be applied.

Requirements for participation:

- *Indicate the minimum requirements that the counterpart institutions in Government Parties would need to meet in order to participate in this project.*

The counterpart institutions in GPs should have domestic funds to support their mutation breeding related research works, dedicated team engaged in field and/or lab works, and basic resource needed by related field works and/or lab works. It is necessary for all participating GPs to have basic facilities such as green house and tissue culture room. The irradiation source or plan for irradiation service sharing with IAEA Lab or GPs should be available. In the same time, the institutions should wish to use at least one of the above mentioned approaches.

- *Indicate the status of expected participating Government Parties as “Resource” or “Recipient”.*

The RCA project has been designed to share expertise and to promote cooperation among GPs, so the proposed project will try their best to maximize ‘sharing’

- ✧ Resource GPs: We will encourage partners to contribute their technology, expertise, resources and other capacities, the institutions which have established one of the approaches will be considered as a resource GP, including but not limited to the following approaches, such as double haploid approach, MAS, cost-effective and high-throughput phenotyping techniques, or mutation techniques.
- ✧ Recipient GPs: By contrast, the users especially those without any contribution will be considered as recipient GPs.

Stakeholder analysis and partnerships:

- *Briefly describe who are expected to be the principal beneficiaries of this project and any role that will be defined for them in the project.*

Crop breeders, related biotechnology researchers and seed companies would be the beneficiaries of the proposed project. The project will provide technical support to participating institutions to enhance the breeding capabilities and accelerate breeding process through technical cooperation; and the participating members will contribute and share their experience to other national crop breeders and related biotechnology researchers. Extension and dissemination of the new MbyS methodology will benefit seed companies.

The role of the breeders and researchers will be to propose improvement suggestions on the new methodology during their utilization, and to utilize the improved protocols in their research process, which could finally accelerate mutant germplasm development process. The role of the seed companies will be to utilize and disseminate the protocols during their crop improvement process, which could finally increase crop productivity.

- *Have any extrabudgetary funding possibilities, sponsors and partners been identified?*

No extrabudgetary funding possibilities have now been identified. Encouragement of international, regional and national seed companies to participate in the project implementation in the dissemination stage of the mutant cultivars will be taken into account.

Have any sponsors/partners been involved at the concept stage?

Partners from the on-going RCA projects have been involved at the concept stage.

- *Have any sponsors/partners made firm commitments of support at this stage?*

The sponsor, the Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, will provide support at the concept design stage.

- *Have any sponsors/partners expressed firm commitments to extrabudgetary support?*

The Institute of Crop Sciences, Chinese Academy of Agricultural Sciences will provide manpower, mutagenesis facilities, cost-effective screening and speed breeding approaches to the proposed project.

Role of nuclear technology:

- *Indicate the essential nuclear technique that is planned be used in this project.*

Nuclear technology including gamma rays, heavy ion beams, space mutagenesis and in vitro mutagenesis etc. will be used to treat crop organisms, and to induce mutations in crops.

- *Outline why it is suitable for addressing the problems/needs in question.*

Nuclear irradiation could induce base mutations in DNA sequence, and result in generation of novel superior alleles / genes, which is the genetic basis of crop diversity and productivity improvement. In the past over 60 years, breeders in the world have released more than 3,200 mutant varieties, which increased crop productivity and produced high socio-economic benefit. So breeders and researchers would prefer to use nuclear irradiation techniques continuously for promoting the diversification of crop production and broadening crop diversity for climate-smart agriculture.

- *Is this the only available technique?*

It is not the only available technique to generate new genetic variations. Transgenic technology and gene editing technique are also alternatives. However, genetically modified organism (GMO) foods are still unacceptable by most public; commercialization of GMO crops especially in wheat, rice, maize, vegetables etc. is still very difficult. Gene editing technique, which has been reported in recent years, is still in experiment stage. It's application in crop improvement still has a long way to go.

- *Does it have a comparative advantage over non-nuclear techniques?*

Nuclear technique does have comparative advantage over non-nuclear techniques. It is a non-GMO technology without biosafety regulations, and it is very cheap and accessible to less developed countries. It has been practically verified in the past sixty years with the more than 3200 officially released plant mutant cultivars in the world.

Duration of the project:

- *Indicate the number of years estimated to be required to complete the project.*

Four years, from 2020 to 2023. The ongoing RAS/5/077 (2017-2020) project focuses on development of new mutant cultivars with improved green traits, which is different from the proposed concept project. RAS/5/077 will be still on-going in 2020, and participating institutions, universities and scientists could continuously benefit from the technical cooperation among GPs.

Part 3: National Representative Endorsement for Project Concept

I have endorsed the proposer to have access to the RCARO web page for the resource documentation necessary to complete the attached concept document.

This 2nd Round Concept meets the RCA project requirements and I endorse it as a priority for the RCA Programme 2020/2021.

Signed:

**Mr. LIU Yongde
Secretary General
CAEA**

A handwritten signature in black ink, appearing to read 'Liu Yongde', is written over a light gray rectangular background.

Date:

Jan.12, 2018

Part 4: RCA PAC 2nd Round Concept Review Template

RCA Project Concept Template Questions	Comment	Acceptable	Revise	Reject
<p>Title:</p> <ul style="list-style-type: none"> <i>The title should be as concise as possible and should summarize the objective of the project.</i> 				
<p>Compliance with the RCA Medium Term Strategy for 2018/2023: <i>All RCA projects have to comply with the RCA MTS for 2018/2023 - please refer to the MTS document.</i></p> <ul style="list-style-type: none"> <i>Briefly indicate to which specific MTS priorities this project proposal contribute.</i> <i>How will these be achieved?</i> 				
<p>Overall Objective:</p> <ul style="list-style-type: none"> <i>State the objective to which the project will contribute. (Note this has to be in line with the RCA MTS for 2018/2023. It should be a short description expressed as: To do)</i> 				
<p>Participating Government Parties:</p> <ul style="list-style-type: none"> <i>List the Government Parties expected to participate in the project.</i> <i>Indicate each of those where you have baseline information on their requirements and needs:</i> 				

Technical Cooperation among Developing Countries (TCDC) Project Component:

Review the documentation on-line - [www.rcaro.org/ ???](http://www.rcaro.org/)

- *Outline the TCDC strategies to be used in the project to enhance regional cooperation:*
- *Will the project design feature partnering arrangements between those advanced and those less advanced in the technology?*
- *If so, list those expected partnerships.*

Analysis of gaps / problems / needs:

- *Outline the major gaps / problems/specific needs to be addressed by the project (~ 300 words):*
- *Review the resource documentation and list any past RCA projects that have addressed similar problems/needs in this area of technology.*
- *What are the major additional capabilities/skills in this area of technology that will be provided through this project (~ 200 words).*

Requirements for participation:

- *Indicate the minimum requirements that the counterpart institutions in Government Parties would need to meet in order to participate in this project.*
- *Indicate the status of expected participating Government Parties as “Resource” or “Recipient”.*

<p>Stakeholder analysis and partnerships:</p> <ul style="list-style-type: none"> • <i>Briefly describe who are expected to be the principal beneficiaries of this project and any role that will be defined for them in the project.</i> • <i>Have any extrabudgetary funding possibilities, sponsors and partners been identified?</i> • <i>Have any sponsors/partners been involved at the concept stage?</i> • <i>Have any sponsors/partners made firm commitments of support at this stage?</i> • <i>Have any sponsors/partners expressed firm commitments to extrabudgetary support?</i> 				
<p>Role of nuclear technology:</p> <ul style="list-style-type: none"> • <i>Indicate the essential nuclear technique that is planned be used in this project.</i> • <i>Outline why it is suitable for addressing the problems/needs in question.</i> • <i>Is this the only available technique?</i> • <i>Does it have a comparative advantage over non-nuclear techniques?</i> 				
<p>Duration of the project:</p> <ul style="list-style-type: none"> • <i>Indicate the number of years required to complete the project.</i> 				

RCA PAC Assessment

Is the concept recommended for further development? YES/NO

If not recommended, what are the major reasons?

RCA PAC Committee Member: