**ICARDA’s Response to the Recommendations of the**

**Center Commissioned External Review of Food Legume Research**

**within the Biodiversity and Integrated Gene Management Program**

**13 May to 3 June 2010**

ICARDA has the global mandate for the improvement of four food legumes – lentil, kabuli chickpea, faba bean and grasspea. In light of the recommendations of the External Program and Management Review (EPMR) of 2006 and the Center Commissioned External Review (CCER) on Integrated Gene Management in 2005, and the development of ICARDA’s new Strategic Plan 2007-2016, ICARDA’s Board of Trustees commissioned an external review of the Center’s food legumes research program.

The CCER Panel comprised Dr. Frederick J. Muehlbauer (Chair), Dr. Xuxiao Zong, and Dr. Massod Ali, supported by two resource experts, Dr. P.K. Joshi on socioeconomics and Dr. Bassam Snobar on mechanization. The review was conducted during 13th May to 3rd June 2010, when the Panel visited the Center’s headquarters and also made on-site visits to the national research programs of Morocco and Tunisia with whom ICARDA works, and to research institutes and farmers in Syria.

The Panel submitted their first draft report on 14th June 2010, which was reviewed by ICARDA for factual corrections. The Panel submitted their final report on 28th June, with a total of 18 key recommendations that the Panel feels are needed to make ICARDA a center of excellence in food legume research. The Center’s response to these recommendations is provided below. Other suggestions and ideas were made by the Panel, but not as formal recommendations. The Center will consider these, but they are not formally addressed in this response.

**Preamble**

ICARDA’s Board and management would like to express their appreciation to the Panel for a highly professional and through review of the Center’s research on food legumes improvement.

Both ICARDA’s management and its food legumes scientific staff have considered the Panel’s recommendations very seriously in drafting this response.

ICARDA particularly appreciates the Panel’s recognition of the global importance of food legumes, and of ICARDA’s significant outputs and scientific contribution in food legumes research, and their overall conclusion that the Center’s food legume program is performing well and prospects for the future are excellent.

ICARDA generally accepts most of the recommendations of the Panel, and where we have some reservations the rationale for these is indicated. As the Panel has indicated, implementation of some recommendations will require additional resources. It must be recognized, therefore, that these recommendations are accepted on the principle that their implementation will depend on resource availability. In this regard, the Center will set priorities based on its needs and available resources.

**Response to Recommendations**

***Recommendation 1:*** *ICARDA has assembled a large and impressive collection of food legume germplasm that includes the related wild species. However, there has only been minimal use of the wild species in the breeding programs. ICARDA with a global mandate for these food legumes should take the lead in the area of pre-breeding and utilize this collection to the fullest extent possible. A strong pre-breeding component to each of the breeding programs would be a major step in making ICARDA a center of excellence for improving these crops.* ***It is therefore recommended that prebreeding using the crossable wild species should be increased and become an integral part of the lentil and chickpea breeding programs.***

**Response:**  **Accepted in principle**. ICARDA acknowledges the need for strong pre-breeding activities and will further strengthen its current pre-breeding activities with crossable wild species, particularly in chickpea and lentil. ICARDA will strengthen pre-breeding as part of the breeding activities in order to make the best and most efficient use of improved germplasm derived from crosses with wild relatives of these crops. This will be done in close collaboration with the genetic resources section and the biotechnology section.

***Recommendation 2:***  *An insufficient number of co-dominant molecular markers are available for genetic mapping in lentil and faba bean. The number of genetic markers can be increased substantially through close collaboration with advanced research institutions (ARIs) such as the University of California – Davis, or the University of Saskatchewan and groups in Australia. Collaboration with the University of Frankfurt has been fruitful toward increasing the number of markers for chickpea genetic mapping.*

***a) It is therefore recommended that the biotechnology laboratory strengthen collaboration with ARIs for marker development in lentil, chickpea and faba bean.***

**Response: Accepted in principle.** The biotechnology section of BIGM recognizes the assessment of the Panel about the paucity of co-dominant markers for genetic mapping of lentil and faba bean, and is therefore striving to have closer collaboration with advanced research institutes engaged in molecular marker development through collaborative research projects.

ICARDA has had collaboration with advanced research institutes, such as the University of Saskatchewan in Canada, various groups in Australia (AgriBio, Centre for AgriBioscience, and the Department of Primary Industries, located at La Trobe University Melbourne), IFAPA (Instituto de Investigación y Formación Agraria y Pesquera), the University of Cordoba, and IAS (Instituto de Agricultura Sostenible) in Spain, and the University of Frankfurt, Germany. It will further increase and extend these collaborations with other advanced research institutes, especially in Europe, working to generate genomic resources for these food legume crops.

***b) It is also recommended that the biotechnology laboratory validate and accelerate the use of molecular markers in the breeding and pre-breeding programs for chickpea and lentil.***

**Response:** **Accepted.** We agree with the recommendation of the Panel. ICARDA has developed intra- and interspecific mapping populations for many important traits in these crops, which will help to make good progress in validating and accelerating the use of molecular markers in breeding and pre-breeding. We will also strengthen the use of molecular markers in alien gene/QTLs transfers into desired backgrounds.

***Recommendation 3:*** *The current chickpea wilt sick plot lacks uniformity of infestation, which causes errors in screening for resistance. Also, dry root rot is becoming a constraint to chickpea production and currently there is no facility for screening for resistance.* ***Therefore, the panel recommends that a new wilt sick plot with greater uniformity of infestation be developed. A dry root rot sick plot should also be established at the center.***

**Response: Accepted in principle.** The current sick-plot for Fusarium wilt (FW) was established about 15 years ago and, we agree, has given some inconsistent results in recent years. We therefore agree with the Panel’s recommendation, and will establish a new sick plot for FW with an area of approximately 1.7 ha. This will increase the throughput of lines to be screened for FW.

As dry root rot disease is not fully established and is not of economic importance in Syria, ICARDA will work in collaboration with other NARS partners, such as Tunisia, to screen lines for dry root rot. We will also explore the possibilities of screening under a controlled environment.

***Recommendation 4:*** *Helicoverpa pod borer is the most important pest of chickpea in South Asia and Sub-Saharan Africa. With climate change, it may become a more important pest in CWANA region. Research on Helicoverpa is currently underway at ICRISAT. It would be highly desirable for entomologists at ICARDA and ICRISAT to collaborate on research on the biology and control of this important pest.* ***Therefore the panel recommends that collaboration between ICARDA and ICRISAT be established for comprehensive research on Helicoverpa pod borer****.*

**Response: Accepted.** Research on pod borer in chickpea has been initiated with screening for resistance in a hot spot site in the south of Syria, and a survey has been conducted of entomopathogenic fungi as potential biological control agents for this pest. This work will be further strengthened in collaboration with ICRISAT under the new CGIAR Consortium Mega Program 3.4 on Pulses and Food Legumes.

***Recommendation 5:*** *Anti nutritional factors in faba bean and grasspea restrict their use in CWANA, South Asia and East Africa. Reducing concentrations of these anti-nutritional factors would increase the value of these legumes for food.* ***Therefore the panel recommends strengthening research on anti-nutritional factors in grasspea and faba bean through additional technical staff and up to date high-pressure liquid chromatography equipment to conduct nutritional quality evaluations.***

**Response: Accepted.** ICARDA accepts the Panel’s recommendation to strengthen research on anti-nutritional factors in grasspea and faba bean. This can be done under the new CGIAR Consortium Mega Program 4 on Nutrition and Health. Pending resource availability, ICARDA will strengthen the capacity of the food legume quality laboratory at ICARDA with advanced equipment and additional staff. Recently, a research technician has been appointed in grass pea improvement as a first step.

***Recommendation 6:*** *In the context of climate change, it is necessary to quantify the effects of higher CO2 concentration, temperature and soil moisture on crop growth, nitrogen fixation and yield of food legumes under controlled conditions.* ***The panel recommends that a program to quantify the effects of climate change on biological nitrogen fixation and yield of chickpea, lentil and faba bean be initiated.***

**Response: Accepted.** We accept the Panel’s assessment that a program to quantify the effects of climate change on biological nitrogen fixation (BNF) and yield of chickpea, lentil and faba bean should be initiated. This will be an important research area under the Mega-Program 3.4 on Pulses and Food Legumes, and ICARDA will ensure these areas are well covered. We are in the process of hiring a microbiologist, who will then assess the effect of climate change, particularly in terms of water stress and high temperatures on BNF and yield of food legumes. Within the breeding programs, studies of the effects of water stress and temperature extremes on yield and yield components are already underway.

***Recommendation 7:*** *Some of the activities of the IPM program are not well focused on addressing the goals of the breeding programs.*

***a) The panel therefore recommends that the integrated pest management program become pro-active in collaboration with the Germplasm Resources Section and the breeding sections in identifying new sources of resistance to important diseases and pests.***

**Response: Accepted.** The IPM Group aims to become more pro-active, in collaboration with both the Genetic Resources Section and the breeders, in identifying and promoting the use of new sources of resistance to important diseases and pests under a changing climate that are relevant to the food legume breeding sections.

***b) The panel also recommends that the IPM program consider the effects of climate change on the likely emergence of new pests and diseases of the food legume crops***

**Response: Accepted.** Within the new CGIAR Consortium Mega Program 7 on Climate Change, the IPM group (pathology, virology and entomology) will undertake several activities addressing the effects of climate change on the emergence of new diseases and insect pests, including new viruses and virus vectors of the food legume crops.

***Recommendation 8:*** *ICARDA has the global mandate for lentil, faba bean, grasspea and shares the mandate for chickpea. Since these legumes contribute substantially to the fertility status of soils through biological nitrogen fixation, it is imperative that all aspects of BNF be studied in depth.* ***Therefore the panel recommends that ICARDA renew its’ efforts to appoint a microbiologist with sole responsibility to undertake comprehensive research on biological nitrogen fixation****.*

**Response: Accepted.** Considering ICARDA’s global role in major food legumes, ICARDA had a very strong program in biological nitrogen fixation (BNF) since its establishment in 1977 up to the early nineties. ICARDA had a BNF team lead by a senior micro-biologist, and as a result ICARDA now has the largest collections of nitrogen fixing bacteria (Rhizobium spp.). After identifying effective Rhizobium strains for the mandated food legumes crops, the BNF program was scaled down to the minimum due to the financial constraints and priority-setting. Considering the importance of BNF in food legumes productivity and nutritional quality as well as soil productivity, ICARDA has already advertised for a microbiologist position in order to study in depth BNF and soil fertility dynamics and promote BNF in ICARDA’s mandated food legumes. This determination to improve soil fertility and health is now even more important with climate change implications.

***Recommendation 9:*** *Each food legume breeding section has several projects and activities but only one scientist for each crop (grasspea combined with lentil). This creates constraints to paying required attention to program objectives, timely publication, and interactions with NARS partners.* ***Therefore the panel recommends that research associate/post doctoral positions be established for each breeding section to assist in plant breeding and to enhance output and contribute to high quality science****.*

**Response: Accepted in principle.** ICARDA recognizes the limited staff resources in the food legume sections. However, ICARDA has already increased staff resources in the food legume program as compared to five years ago (e.g. a full time faba bean breeder, a food legume breeder for South East Asia based in India, and a food legume breeder based in Ethiopia). Pending availability of resources, ICARDA will continuously explore new possibilities to establish research associate and/or post-doctoral positions in the legume breeding sections.

***Recommendation 10:*** *The Genetic Resources Section (GRS) has part time curators, one for cereals and one for legumes, which limits their opportunities for research on the germplasm.* ***Therefore the panel recommends the appointment of an additional curator for food and feed legumes to more effectively carry out the functions of the GRS****.*

**Response: Accepted.** ICARDA recognizes the limited staff resources in GRS on legumes. ICARDA will continue to look for opportunities to attract donor’s financial support to fund research on food legume genetic resources, as these may contain novel genes of great interest.

***Recommendation 11:*** *In the context of climate change and changing fertility status of soils in addition to releases of new germplasm, crop management practices for the region need to be updated and refined. Specifically, new sets of crop management trials should be initiated at selected NARS sites on tillage options, nutrient application and status, drought and weed management.* ***We therefore recommend that an Agronomist be appointed for food legumes to work with NARS agronomists and field crop specialists to develop and refine crop management practices for newly released varieties and the changing environment throughout the region****.*

**Response: Partially accepted.** ICARDA recognizes the important role of agronomy to increase production and has just appointed a cropping systems agronomist. Thus, food legumes agronomy will be fully integrated into the agronomy research program of the Diversification and Sustainable Intensification of Productions Systems (DSIPS) Program. However, considering that management practices are location specific, ICARDA expects its national partners to also play a very important part in refining the crop management practices of newly released varieties in their countries. ICARDA’s agronomist will work closely with his national counter parts on these research areas.

***Recommendation 12:*** *ICARDA has a highly qualified and competent scientific staff to offer training and guidance to students pursuing degree programs. To attract students from NARS* ***the panel recommends that fellowships be provided to support degree programs. In service candidates may also be given the opportunity to acquire advanced degrees.***

**Response: Accepted.** ICARDA already conducts a graduate research training program (GRTP) from its core and project funding, where students from NARS are supported in conducting research at ICARDA and registered at local, NARS or ARI universities. At present ICARDA is training several students at the graduate and post-graduate level from Ethiopia, Morocco, Sudan, and Syria. ICARDA will strive to mobilize more funding for graduate or degree training, and will solicit more training opportunities for national scientists in food legumes.

***Recommendation 13:*** *Many of the professional and technical staff of the NARS programs lacks sufficient training in the areas of crossing techniques and plant breeding. This is especially true for programs where there have been recent personnel changes.* ***It is therefore recommended that ICARDA expand opportunities for NARS scientists and technicians to upgrade their skills in these areas.***

**Response: Accepted.** ICARDA is in agreement with the recommendation on the need for more skilled national scientists in crossing techniques and breeding methodologies. ICARDA will further increase needs-based training opportunities for NARS scientists and technicians to upgrade their skills particularly in the areas of practical plant breeding in addition to biotechnological tools that enhance breeding efforts.

***Recommendation 14:*** *A major constraint to adoption of new chickpea and lentil varieties has been the seed production and distribution system in most of the non-tropical dry areas, including Syria. A more efficient system is crucial to delivering new varieties and production packages to the farmers.* ***It is therefore recommended that ICARDA take the lead in formulating and promoting an efficient seed delivery system in cooperation with NARS partners that will enable the timely distribution of improved varieties and production packages to the farmers****.*

**Response: Accepted.** ICARDA is in agreement with the Panel’s observation that seed multiplication is a bottle-neck for the adoption of improved food legumes by farmers. Thus, we accept the recommendation and will make efforts to better integrate the breeding activities with seed delivery systems in food legumes varieties to improve adoption and impact.

***Recommendation 15:*** *Over the years ICARDA has contributed to the development of new and promising varieties of food legumes and production technology for NARS; however, many new varieties are not taken up by the farmers.* ***The panel recommends timely assessment of the impact of improved varieties and new production technology.***

**Response: Accepted.** ICARDA acknowledges the importance of timely implementation of adoption and impact assessment studies that explain the main barriers to varietal adoption and provide feedback to research, extension and policy makers. Several studies of the adoption of food legume technologies have been recently undertaken. ICARDA therefore accepts the recommendation on timely monitoring of the adoption of new varieties to identify and overcome constraints to adoption, and the evaluation of their impacts on food legume production in the major legume growing regions.

***Recommendation 16:*** *With climate change, the scenario of insect pests and diseases will be altered and new races of pathogens and insects may emerge and pose serious threats to productivity.* ***Therefore the panel recommends that a spatial disease map be developed in collaboration with the GIS unit to formulate prediction models on occurrence and severity of diseases that can be used to plan research and design management practices****.*

**Response: Accepted.** We agree with the Panel’s recommendation and the observation on changing biotic stresses due to climate change. Within the new Consortium Mega-Program 7 on climate change, the IPM group will work with the GIS unit and ARIs to develop distribution maps and prediction models for changing dynamics of diseases and insect pests of food legume crops due to climate change.

***Recommendation 17:*** *Zero tillage has proved promising in several areas as it reduces the cost of production, facilitates timely planting and improves soil health. Limited research on zero-tillage has been carried out by the center.* ***Therefore the panel recommends that a comprehensive research program on zero tillage be established, emphasizing food legumes****.*

**Response: Accepted.** ICARDA already has a large R4D program on zero tillage conducted in collaboration with national programs. This program, which is mainly supported by a large project (phase 2) over the past 5 years on restricted funding, has shown that the zero-tillage technology is promising for both cereals and legumes. Yields are generally better under zero tillage and ICARDA varieties bred in cultivated systems perform well under zero tillage. Besides the senior conservation agriculture specialist, a cropping systems agronomist has just been appointed and will expand on this work, especially to understand underlying mechanisms and principles. The breeding and IPM groups, including those working on legumes, will cooperate with the expanded agronomy team and incorporate sustainable zero tillage technologies into germplasm and IPM R4D.

***Recommendation 18:*** *Faba bean is an important food legume crop in North Africa where it is produced on over 300,000 hectares. From the visit to Morocco, it was apparent that most faba bean breeders in North Africa are isolated and lack current information on technical aspects needed to conduct effective breeding programs to alleviate constraints to production.* ***It is therefore recommended that a faba bean workshop be organized by ICARDA to bring scientists and plant breeders together to share information on faba bean for mutual benefit and to develop regional cooperation and networking.***

**Response: Accepted.** After the unsuccessful devolution of ICARDA’s faba program to the Moroccan National Program to take a regional lead in the early nineties based on the recommendation of the CGIAR Technical Advisory Committee (TAC), ICARDA had to re-establish the faba bean program after losing valuable germplasm due to three consecutive dry seasons in Morocco. ICARDA started to re-develop the faba bean pre-breeding program towards the end of the nineties and two thousand. It started the re-development of the faba bean breeding program with the appointment of a faba bean breeder in 2007. The interaction with North African NARS has already been initiated by the new faba bean breeder, who visited Morocco, Tunisia and Egypt to assess the needs of the national breeding programs. We agree with the Panel on the importance of holding an international workshop to re-activate the global faba bean network that ICARDA had before devolving the faba bean program to Morocco. ICARDA will look for an appropriate time and resources to conduct this workshop.