2007 BIC Workshop – Panels

1.) Private Sector

Private Seed Companies: Fred Bliss

Agri-processing industry: John Rayapati

European companies: Gerthon van de Bunt

2.) Producers:

Processor Industry: John Andrews

Fresh Market: Ken Kmiecik for Mike Borzynski

Dry Bean: Greg Varner

3.) International / National Programs

USDA-ARS: Talo Pastor-Corrales

CIAT-Colombia: Steve Beebe

EMBRAPA-Brazil: Josias Feria

Europe: Antonio M. De Ron

4.) University Programs

Oregon State University: Jim Myers

Colorado State University: Howard Schwartz

University of California, Davis: Paul Gepts

Michigan State University: Jim Kelly

Questions to be Considered

- *Future of your organization or type of organization:*
  - *Goals*
  - *Direction*
- *Outlook: financial, potential growth, etc*
- *Needs to remain competitive*
- *Research issues*
- *Relationship to an organization such as the BIC*

Private Seed Companies - the future role of BIC

Fred Bliss,
Seminis Vegetable Seeds, Woodland, CA and UC Davis, Davis, CA

- Future of Seminis in the private seed company sector:
  - Goals – provide high quality seed of varieties that provide healthy and safe food to consumers and assist growers in remaining profitable.
  - Direction – Focus on key markets using appropriate technology to improve the efficiency and effectiveness of classical breeding.
  - Outlook: financial, potential growth, etc. Snap beans remain an attractive crop that should remain profitable. We look for the fresh market product to continue to be strong, with some growth, while processed product will be flat at best.

- Needs of bean seed companies to remain competitive:
  - Attractive consumer products for minimal preparation time, convenience and nutritional quality.
  - Resistance to biotic diseases and insects, tolerance to abiotic stresses that allow more cost efficient production, IPM and reduced chemical reliance.
  - Additional basic research investment in the public sector and effective links between public and private programs.
  - Additional breeding and infrastructure in the public sector.

- Research issues for beans:
  - Erosion of breeding and research infrastructure for horticultural crops in the U.S. especially at the state level.
  - Lack of sufficient infrastructure globally for these crops.
  - Additional basic research investment in the public sector and effective links between public and private programs.
  - Increased resources for applied genomics aimed at productivity, pest and stress resistance, and product quality.
  - Too little effective use of poorly-adapted (wild) germplasm to effectively broaden the genetic base of cultivated snap and dry beans.

- Relationship of company to an organization such as the BIC
  - The BIC has been very effective as shown by its viability over the past 50 years. It is user driven, efficient, and effective.
  - BIC has a forum for non-refereed articles which was ahead of the crowd and it remains an effective means of communication. Continuing to add electronic information for the user community will keep it relevant.
  - The meeting format of every two years, in a different location at this time of the year seems to have been a winner. We will continue to offer support.

Notes from Industry Representation at 2007 BIC

John Rayapati

1. The Archer Daniels Midland Company is a family of businesses committed to global leadership in biofuels and agri-processing. ADM Edible Beans Specialties is a food ingredients business designed around a vertically integrated seed-to-table model. Dry beans and their powders are the food ingredients with the most health benefits in ADM's portfolio of ingredients. ADM's quality control practices make great efforts to deliver allergen-free beans and bean powders to its customers. Use of bean powders in breakfast and snack foods is a way that ADM's customers can improve the quality of their products by using a product represented twice in the USDA food pyramid.

2. The certified-organic dry bean market is small and being successfully addressed by the University of Idaho.

3. Genetic engineering that results in the GMO regulatory status and labeling is not in demand by end users of food ingredients. Growers will benefit the most from traits improved by genetic engineering. Genetic engineering that does not result in "transgenic events" and the products of which are classified as non-GMO has appeal. One source of non-GMO technology for herbicide tolerance is found at http://www.cibusllc.com/. This form of oligonucleotide-mutagenesis that is classified as chemical mutagenesis by the USDA has the potential to reach the marketplace in the near future.

4. The dissection of the structure and function of gene products for traits like recessive viral resistance provides targets for genetic engineering approaches to generating new alleles and to for designing improved markers for breeders. When consumers reject transgenic tools, they are making a choice for more rigorous exploration of biodiversity. Understanding the structure and function of loci governing value-added traits facilitates cost-effective screening for genetic variation in specific gene families in germplasm collections.

5. Viruses greatly limit the quality and quantity of seed production. The work of Dr. Jahn's research team on recessive resistance combined with the results from Vallejos et. al on the dominant I locus represent a quantum leap in the understanding and application of genetics to breeding. The BIC is a critical interface between university and industry researchers that is succeeding in communicating progress.

6. In recognition of the valuable contributions of the BIC to industry, I offer seed increase and maintenance services for critical mapping populations.

The Processors and Their Relationship to BIC

John Andrew, jandrew@lakesidefoods.com

My comments as a processor relate primarily to the canning and freezing of succulent beans. Vegetable processing is a mature business that has gone through very extensive consolidation in the last 35 years. The 70-80 processors that were in Wisconsin 35 years ago have been reduced to 3-4 major and several small producers. Sales are relatively flat for both canned and frozen. It is difficult to predict what direction we will be going in the next 15-20 years. The forecast for the demise of canning twenty-five years ago has proved to be not true. If there is a change in format for the way processor delivers their vegetables to the consumer, the cost of energy and container materials will play a strong role. Both canning and freezing use extensive amounts of energy and water. Can alternative packaging methods be developed that require less expensive materials or consume less energy and water in the process? We are currently in a period of high cost pressures from energy and the procurement of raw product. The rising cost of energy is creating a situation where the demand for farm produce is from energy production as well as human consumption and animal feed. In addition, current farm law adds to the cost of raw product through financial dis-incentives to farmers who either do not have a vegetable acreage base or have a limited vegetable base. This creates an artificial shortage of land available for vegetable production. The cost of vegetables to the consumer has been rising as have most other food product. However, costs are difficult to pass on. Rising prices tend to reduce demand.

We are in an age of intelligent consumers having strong awareness of nutritional values and food safety. Our customers have high expectations for good quality, wanting a product with good taste, texture and color, that has good nutrient value and they also demand that is void of all contaminants including bean plant material. The concern for food safety has created a leeriness of pesticides and GMO's. There is also a segment of our society that believes that the resistance of bacteria to antibiotics may be initiated on the farm where antibiotics are used in the production of our food. Is it possible to prove or disprove such a theory? What are our alternatives if the theory is valid?

Any discussion about preparing for the future through research should involve regional climate changes from global warming. Will there be significant amount of change to alter cultural practices or varieties selection? Will new pests become a factor in the production of vegetables? Can we predict with any confidence if Midwest will continue to be warmer or if we will have drought conditions or increased rainfall?

The opportunity that is most strongly presenting itself to food processors at this time is organic production. The controlling of weeds has been the major obstacle to organic production of succulent beans in the mid-west. Recommendation for nutrient sources and materials to control insects and diseases has come primarily from organic organization and sales reps of companies selling the products. The BIC could be instrumental in the development of Organic production practices by providing evaluation of nutrient sources and pest control materials.

A second opportunity is the production of fine beans. There probably is a large stable of varieties from which selections that are suitable for production in the Midwest could be made. However, I am not sure that processing systems are in place to accommodate the small pod size.

Issues that could be addressed by the BIC are:

1. Increasing the Nitrogen production of succulent beans and developing cultural practices to preserve the Nitrogen that is produced.
2. Review seed management practices to ensure that diseases, in particular blights, are not transmitted to production fields by seed.
3. Plant structure and how it relates to harvestability. Clean picked beans increased the productivity of the factory and reduces the EVM contaminates in the product, a major consumer complaint.
4. Determine the nutrient variability of varieties. Labels currently display the minimum level of a particular nutrient. Can the nutrient level be raised with the selection of varieties that provide higher levels of a nutrient?

International/National: 'As we look to the future what are the concerns we have today and what is the future of the BIC'

Comments by M.A. Pastor-Corrales, ARS-USDA, Soybean Genomics and Improvement Laboratory, Beltsville Agricultural Research Center, Beltsville, MD 20783

Although none of us can predict the future, there is one thing that we can say; it will be different. New technologies in particular will be the main cause for change, especially for the way we do things, whether what we do is common bean improvement, nutrition studies, genomics, etc. However, through the years of its existence, the BIC has developed certain "personality attributes" that I believe the BIC members should try to continue and enhance. Among the most salient attributes are the facts that the BIC is rather international, diverse, its members open to collaboration, and that the BIC is mission oriented.

In regard to the international aspect of the BIC, the world seems to get smaller and our relations more global. I believe that the BIC leadership, in addition to emphasize participation from bean scientists from the USA, Canada, and Mexico, should also continue to seek membership and active participation from our colleagues from other bean production countries of Central and South America and the Caribbean, Africa, Europe and even Australia and Asia. These members bring a different perspective, professional experiences, and above all, common bean germplasm that benefit the entire BIC community. In that regard, I wish that CIAT would be a more active participant. Along with this international aspect comes the aspect of diversity, whether we are considering genetic diversity of *Phaseolus vulgaris* or its pathogens and insects, but also the diversity of our membership: different research orientations. I believe that it would be to the BIC advantage that this institution does not become a breeder's club or a genomics' club but rather a BIC in which we all can be benefit from broad genetic diversity of the crop, form the broad diversity of our colleagues professional experiences, from broad collaborations, and so on. These two attribute of the BIC Internationality and diversity also contribute greatly to, what in my opinion is the best attribute of the BIC, open, friendly, and effective collaborations that benefits all parties concerned. These collaboration should become an essential part of the BIC culture; collaboration that involves different professions, industry, university and government scientists, all for the solution of the complex problems that agriculture is continually facing. In the final analysis, these collaborations have been very effective in advancing bean science, in the publications of excellent manuscripts, in developing genetic and other solution to our understanding of g the origin and evolution of the bean crop, its biotic and abiotic constraints. Also it has permitted extensive traveling to other bean production places, and above all, it has enhanced the BIC' mission to improve and make available more and better dry and snap beans s for producers and consumers alike.

I believe that despite the fact that we can't predict what the future will bring, we use some basic attributes already present in the BIC's genome to make the BIC a better and more successfully vehicle for the improvement of the common bean.

International: CIAT's perspective on the future of BIC - Steve Beebe

Future goals and directions of CIAT:

CIAT (the International Center for Tropical Agriculture) is one of the centers of the Consultative Group on International Agricultural Research, a loose confederation of publicly funded research institutes created in the 60's and 70's to address agricultural needs in the developing world. CIAT holds the mandate within the CGIAR system for *Phaseolus* research, and thus common bean research will remain among CIAT's priorities.

Outlook:

Like all public research institutions, CIAT has seen a reduction in its core funding over the past two decades, and a move toward special project funding. Perhaps 70% of such funding for beans is focused on eastern and southern Africa where common bean is the primary food legume.

Organizational needs:

CIAT's traditional research partners have been the national research institutes (comparable to the USDA) in developing countries. While national programs continue to be our primary partners in the generation of technology, in recent years a wider gamut of actors have become involved in the diffusion of technology, in addition to governmental extension services: international, regional and local NGO's; small and medium sized seed businesses; nutrition based projects; among others.

Research issues:

Biofuel is becoming an overriding issue in tropical agriculture, although at present most effects on beans are indirect. Maize prices have doubled, leading to expanded production and potential competition for land with beans in some production systems. Soybeans might also compete in some areas. This may push beans into even more marginal areas, and increase the need for abiotic stress tolerance, especially in light of climate change. However, there is a shortage of physiological expertise in the bean community, and whole plant physiology in general has declined as a discipline. This is a serious problem for the future.

In Latin America there are still production issues of biotic and abiotic stresses. However, urbanization is approaching 80% of the population, so the farming sector is diminished, while chronic diseases associated with a sedentary lifestyle, overnutrition, and a high fat diet (obesity, diabetes, cardiovascular disease) are increasing. This implies a role for beans as a culturally acceptable food with important health benefits. Latin America could have a special role to play in investigating the linkages between agriculture, diet, beans and health because, 1) there is a well developed nutrition community here, with professional societies and publications; 2) many Latin American nutritionists have a public health perspective that is open to the concept of modifying a population's diet, as opposed to a clinical approach that may prevail elsewhere.

In Africa increasing productivity remains a high priority, as the region suffers from a production deficit. Both biotic and abiotic stresses must be addressed. Nutrition issues are also of high priority but are of a different nature than in Latin America. Under nutrition is still an issue, as well as improving diets for persons living with HIV/AIDS to enhance the effectiveness of anti-retroviral drugs. Improving the concentration of iron and zinc in grain is an important nutritional breeding objective.

Asia is still largely an unknown with regards to the true importance of beans, but anecdotal information suggests that beans are increasing in India where legume consumption is traditionally high. Even minimal per capita consumption in India would represent many thousands of tons!

Relationship to BIC:

For CIAT, the BIC is an important point of contact with the North American bean community, which is the only major *Phaseolus* research community in the developed world with a production focus.

International - Antonio M. De Ron

Spanish National Research Council
("Consejo Superior de Investigaciones Científicas" – CSIC)
Misión Biológica de Galica. Pontevedra, Spain
Head of Plan Genetic Resources

Spanish Association for Legumes
("Asociación Española de Leguminosas" – AEL)
President

MARKET AND CONSUMPTION TRENDS

- High quality market classes: geographical identification and legal regulation (IGP)
- Traditional landraces: financed by the European Union Commission through the Regional Government
- Promotion of legumes consumption as a healthy food
- Promotion of legumes as environmentally friendly crops

SUMMARY OF DRY BEAN MARKET IN SPAIN

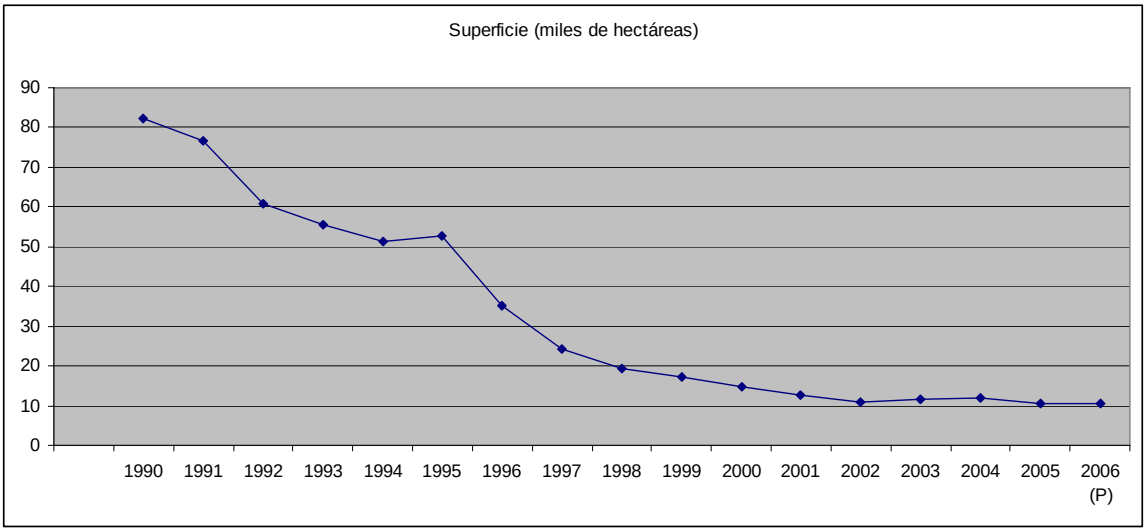
Years	Production (t)	Imports (t)	Exports (t)	Balance (t)
1990	52,800	29,600	3,264	79,136
1991	46,500	48,012	2,903	91,609
1992	36,100	57,836	321	93,615
1993	30,100	54,057	1,016	83,141
1994	33,000	54,817	1,503	86,314
1995	32,400	62,949	6,067	89,282
1996	29,400	57,790	3,174	84,016
1997	23,200	51,183	5,993	68,390
1998	20,800	55,907	6,769	69,938
1999	19,700	59,288	5,269	73,719
2000	18,800	56,577	5,948	69,429
2001	15,420	56,436	4,706	67,150
2002	13,106	56,477	4,922	64,662
2003	14,823	59,389	4,530	69,682
2004	15,888	60,182	4,531	71,539
2005	14,815	50,367	5,641	59,541

COMMON BEAN GERMPLASM AVAILABILITY IN SPAIN

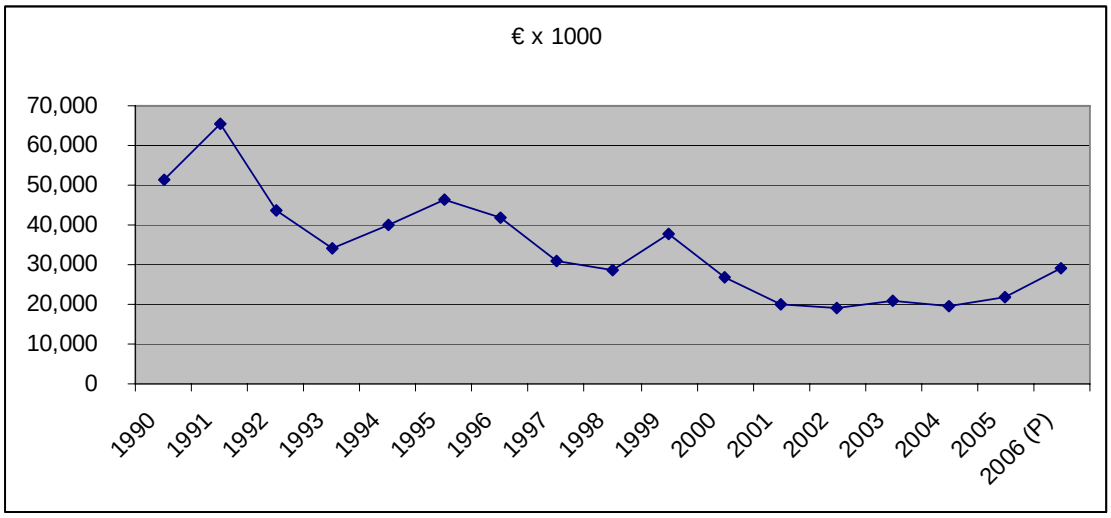
- Center for Genetic resources (CRF-INIA):
  - 2846 accessions

- MBG-CSIC:
  - 1853 accessions

GROWING AREA IN SPAIN (ha x 1000)



MARKET VALUE IN SPAIN (€ x 1000)



BIC - the next 50 years: A public breeder's perspective

James R. Myers, Department of Horticulture, Oregon State University

In attempting to discern the future of the bean breeding and genetics research, we must be cognizant of forces acting on human society over which we have little control. These include changing climate, increasing population, globalization, and energy. In "The End of Agriculture in the American Portfolio", Steven Blank describes economic forces acting on agriculture. Land use shifts to the highest monetary value, which is in real estate, not agriculture. Consequently, agriculture moves to developing countries where production costs are cheapest (lowest labor costs). The only significant "agriculture" to remain in the U.S. will be golf courses, turf farms and nurseries. If this vision of agriculture in America comes to pass, there will be no future in it for beans.

My vision is not as bleak. What happens to American, and ultimately world agriculture is a societal decision. If we want farms in America, then society may need to subsidize them, such as currently happens in regions of Europe. Blank also overlooks the entrepreneurial and innovative abilities of American farmers, who substitute knowledge and technology for labor. There are also positive trends such as renewed public interest in food and health with emphasis on fresh, flavorful, local, sustainable, and healthy. The private sector and USDA have recognized the neglect of plant breeding. Recent efforts to rectify the situation include the USDA-CSREES plant breeding and education grant program, the specialty crops program, and Pioneer funding of graduate assistantships in plant breeding at universities.

If there is no societal decision to grow American agriculture in the next 50 years, the universities' traditional role of training, research, and extension will remain. But, we will see continually shrinking Federal and state budgets. Positions will not be replaced, and departments will shrink. As departments shrink, they are eliminated altogether, or are merged into super-departments that continue to shrink. It is a good bet that in 50 years, we will see a reduction in the number of land grant universities, with just a few regional hubs representing the various production areas of the U.S. Another trend will be the privatization of agricultural research, such as has happened in Great Britain and Australia. One way to resist these trends is to preserve positions through the development of endowments and sponsorships.

I hesitate to predict what breeding and genetics topics will be *du jour* in snap beans in 50 years. In the near term, we will continue breeding white and gray mold disease resistant cultivars. There will be other emerging diseases, such as bean golden mosaic and tomato yellow leaf curl viruses, and soybean rust. Genomics will allow us to understand the genetic architecture of snap beans, and may lead to more efficient breeding strategies. Genomics may also solve the "rogue" or off-type problem in snap beans. If reliable CMS pollination systems are developed, we may have hybrid snap bean cultivars in 50 years. As production shifts to the tropics and sub tropics, snap beans with resistances to the diseases and insects that cause pod damage will be needed.

There is not much that I would change about the BIC. It has served well as an "informal" means of information exchange and this role should continue. The BIC can be instrumental in organizing support for retaining *Phaseolus* positions in the USDA and at public institutions. A new initiative for the BIC might be outreach to the public, with the idea that we should have a role in influencing societal policies towards agriculture.

Future Direction of the BIC - University Program Perspective

Howard F. Schwartz – Colorado State University
Applied Research Scientist and Extension Specialist

During the first 50 years, our BIC composition was diverse:

- Disciplinary Focus – breeding, genetics, genomics, plant pathology, entomology, agronomy, soil science, physiology, weed science, food science
- Research Focus – basic, applied
- Outreach Focus – extension and demonstration, direct linkage to bean industry, growers and other clientele
- Teaching Focus – production and pest management strategies to students, distance learning and professional improvement support for industry personnel and growers

During the next 50 years, our BIC composition will become less diverse:

- Disciplinary Focus – genetics, genomics, pest resistance mechanisms, ecology, food utilization and health
- Research Focus – basic (genomics), applied research positions will continue to disappear and genomics people may even fade if the BIC loses its luster
- Outreach Focus – continue to be phased out, less contact with and input from industry, growers and other clientele
- Teaching Focus – bean molecular genetic applications only will be taught to students, loss of production and pest management systems approach

University Program Perspective –

- ❖ Disciplinary diversity, applied research and outreach foci, and industry linkages will continue to erode and disappear;
- ❖ in response to academic, political and funding pressures that began during the last 20 years; and
- ❖ which could continue to reduce the depth and breadth of our BIC Membership.

BIC Organization and Member Action Plans:

- ❖ *Fight the Erosion* in University Bean Positions;
- ❖ *Develop Strategic Plans* with BIC Input;
- ❖ *Change the Mind-Set* of Administrators & Sponsors; and
- ❖ *Regain a Better Balance* of Research, Outreach, Education and Industry Partners that reflects the roots of our original Land Grant Mission in the University System.

Paul Gepts, University of California, Davis

1. Future of your organization or type of organization:

The University of California, Davis campus is one of 10 campuses of the University of California system and one of three UC campuses that belong to the California Agricultural Experiment Station. Although the ten campuses have a large autonomy, they also function in some areas as a unit. For example, in terms of research, Agricultural Experiment Station research is often compared to non-AES research on the same campus (e.g., with College of Biological Sciences) or other, non-AES campuses (e.g., UCLA, UC San Diego), which often conduct more basic research. Hence, you will often see a more basic bent to research combined with applied research coming from the UC AES.

This more basic bent is likely to increase especially at the AES component is under stress due to reduced funding, as is the Cooperative Extension component. In my department, the "genetic pipeline" for individual commodities included a geneticist (more basic genetic research), a breeder (germplasm and varietal development), and a cooperative extension specialist (varietal testing as a component of research and extension on cultural practices). Some of these positions have been eliminated or combined. This will most probably be the case when I retire. I do not expect to be replaced unless there is a strong movement both from within and outside the state to maintain the focus of this position. At best, my replacement will address crop diversity, and *Phaseolus* may be one of the experimental emphases of my replacement.

2. Outlook: financial, potential growth, etc.

The central question is: how can beans compete with subsidized crops, such as corn, soybean, cotton, etc.? I suggest that there are several points to emphasize: 1) Beans are a specialty crop, which should make them eligible for funding resulting from the new Farm Bill; 2) Beans play an important role in human nutrition, as a low-fat source of proteins, certain vitamins, and some minerals; 3) Beans can also play an important role in human health by decreasing blood sugar and cholesterol content, as an anti-oxidant, and an anti-cancer agent. Beans are the only food mentioned in two distinct categories of the USDA food pyramid, as a protein source and a vegetable/fruit. The role of beans is most important in developing countries, particularly in Latin America and the Caribbean, and Eastern Africa, where some of the highest per capita consumption of beans exist. Among these countries, two middle-income countries, Brazil (1st producer) and Mexico (3rd producer), have the scientific wherewithal to conduct large-scale genetics and genomics projects in beans. Beans (and other grain legumes) are a substitute for meat, a characteristic that will become more important as pressure on land and urgency to decrease the emission of greenhouse gases increases.

Can beans remain (be) competitive in research funding? I am pessimistic at this stage: The funding situation does not mirror its importance in the human diet. Part of this may be due to the emphasis on starch crops (cereals, cassava, for example) on the part of funding agencies. Yet, a balanced diet requires a reliance on a diverse diet; this requires that funding go to other crops than the main staple crop.

Can we access specialty crop funding? Specialty crop funding should certainly be available for green beans, and perhaps also for dry beans. More basic research could also access specialty funding because it is relevant to both green and dry beans. The national bean industry needs to play a larger role (similar qualitatively if not quantitatively) to what the United Soybean Board does for soybean: develop and administer a check-off that funds research. In addition, it needs to represent growers (like the National Corn Growers Association) with national funding agencies to educate funding administrators of the importance of beans for agriculture and human consumption.

3. Research issues in the genetics area

The main agenda point from a genetic standpoint is to develop and use genomics tools. The main goal is to better understand the molecular basis of important phenotypic traits for bean breeding and to provide the raw material for marker development (sequence-tagged sites: SSRs, SNPs, CAPS, etc.). There are three types traits to focus on: 1) Traits for bean researchers: e.g., broadening the genetic base; 2) Traits for farmers: e.g., disease and pest resistance; developmental biology; and 3) Traits for the public: e.g., pod and seed; quality and human nutrition.

4. Relationship to an organization such as the BIC

What is the BIC's role? The BIC currently plays an important in facilitating information among members and outside the BIC membership by organizing a biennial meeting, publishing an annual report, and maintaining a web page. I suggest that BIC can play a more active role of representation of the bean research community in support of research funding and new (or replacement) positions. To achieve this, it can use its web site and annual reports, but it should also expand contacts with grower, marketing, political, and funding organizations.

Sustaining Public Bean Breeding Programs - James D. Kelly, Michigan State University

As researchers we all recognize the changing role of public plant breeding programs in our society. In addition to the more traditional role of increasing food, feed, and fiber, human health and food safety concerns are the new issues that the public expects from agriculture and the research that supports that industry. The shrinking population involved in agriculture is placing higher value on the products of agriculture and less on production issues. There has been major attrition in federal positions in bean research and in state funding confounded with shrinking acreage that generates local financial support for research. In addition it is increasingly difficult to justify the replacement of public breeders at major institutions following retirements. Land Grant Institutions are becoming World Grant Institutions that generate competing international programs which further siphon off limited personnel resources. The challenges facing public bean breeders will be to demonstrate impact in a commodity that lacks financial support and the critical mass of researchers in both the basic and applied fields.

On the private side, industry needs for varieties, improved germplasm, and new technologies have not changed greatly. Industry effectively leverages its funding by redirecting research in cash-starved public programs with modest investments. With the expansion of private sector plant breeding, the traditional applied research that generated revenue is being pried from the public sector. Who is expected to pay for the basic research in demand? Again future progress is handicapped by IP issues and by restrictions imposed on the type of research needed. Genomic research is limited as GM beans are not accepted in the marketplace. One critical area that is not being addressed equitably is the future training needs in applied plant breeding, given the increased costs of graduate education. Despite these differences there is a clear need for innovative partnerships between the public and private sectors and a better understanding of each others needs, as is being expressed in this workshop.

Limitations imposed by the market class diversity, restricted basic research, loss of USDA positions, lack of major federal $upport and political clout all hinder progress of the few active bean breeders. However, opportunities do exist. According to the USDA ERS, American consumers need to increase vegetable consumption by 31% based on the USDA food pyramid. This would increase vegetable production by 8.9 million acres to 15.3 million acres from the current level of 6.5 m acres. The increase in legumes alone would be 8.8 m acres as other commodities would be decreased. The need for a national discussion on the food vs. fuel issue with an emphasis on conservation not consumption is critical as the demand for food could become a national security issue if food prices continue to increase. The question arises from where will that food come and how safe is the food. It is unlikely that the US will import beans over higher-priced commodities, yet the aging US population is becoming more attentive to diet and the value of beans in controlling obesity, type II diabetes and certain types of cancer. As traits valued by consumers are being targeted for improvement, there should be broader acceptance of GM crops. Greater investment in bean breeding is needed to support basic research including genomics research.

Projections: In reviewing 50-years of bean breeding activities in the BIC reports, breeders continue to focus on many of the same problems/traits as in the 1950's. What I see as opportunities in the future are largely advances in applied genomic research. The need to continue field selection for yield, local adaptation, and grower friendly traits will always exist. However if scientists can routinely transform bean, freely move genes between species, transformation cassettes (mini-chromosomes) need to developed that can be inserted into cell organelles that provide different combinations of disease resistant traits that vary by region, combined with different combinations of traits functional against abiotic stresses and specific biochemical traits that enhance nutrition and processing quality of future bean varieties.