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Major constraints and trends for common bean production and commercialization; establishing priorities for future research

Principales restricciones y tendencias en la producción y comercialización de fríjol común; estableciendo prioridades de investigación

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ABSTRACT

In order to identify the principal constraints and trends for common bean production and commercialization and the priorities for future common bean research in Africa, Latin America and the Caribbean (LAC), a priority setting process was developed at the International Center for Tropical Agriculture (CIAT). The results suggested that the principal research included breeding and selecting for several traits, such as drought tolerance and water use efficiency, improved yields, and consumer acceptance. Additionally, the results of the priority setting process suggested that institutional measures are needed, such as improving formal seed production and distribution channels and the development of national and regional seed policies. On the other hand, the identified principal constraints included diseases, pests, and market constraints. Finally, the identified principal trends were: increase in demand and production, and development of high-yield varieties and improvement in nutritional quality.

Key words: research options, constraints analysis, scoring model.

RESUMEN

Con el fin de identificar cuáles son las principales restricciones y tendencias en la producción y comercialización y las prioridades de investigación del fríjol común en África, América Latina y el Caribe (ALC) desde el Centro Internacional de Agricultura Tropical (CIAT). Los resultados indican que las prioridades de investigación incluyen el mejoramiento de ciertos rasgos tales como tolerancia a la sequía y eficiencia en el uso del agua, mejoramiento del rendimiento, y el mejoramiento de características que permitan una mayor aceptación por parte de los consumidores. Adicionalmente, los resultados sugieren que es necesario tomar medidas institucionales, tales como la certificación en la producción de semillas y los canales de comercialización, y el desarrollo de políticas nacionales y regionales de las mismas. Por otra parte, las principales restricciones identificadas fueron las enfermedades, plagas y algunos problemas relacionados con los mercados. Finalmente, las principales tendencias identificadas son el incremento de la demanda y la producción, y el desarrollo de variedades con mayores rendimientos y con mejoras en la calidad nutricional.

Palabras clave: opciones de investigación, análisis de restricciones, modelo de puntuación.

Introduction

The common bean is the most important source of proteins for nearly five hundred million people in Africa, Latin America and the Caribbean (LAC) (Cortés *et al*., 2013); in particular, for low-income earners (Rosas *et al*., 2000). It is also an important source of nutrition, serving as a source of iron, potassium, magnesium, zinc, and folic acid (Mederos, 2006). In 2010, global bean production was approximately 23,816,123 t, with 24.4 and 17.7% of the world production in LAC and Africa, respectively (FAO, 2014).

In spite of the nutritional and economic importance of beans, it is a low-yield crop (Tab. 1). These relatively low yields can be explained mainly by the many kinds of biotic and abiotic stresses that affect the bean during its cultivation (Cardona *et al*., 1981; Cardona *et al*., 1982; Schwartz *et al*., 1982; Morales *et al*., 1988; Pastor-Corrales and Schwartz, 1994; Kajumula and Muhamba, 2012).

Given the importance of beans as a source of protein and nutrition, they have the potential to serve a useful role in both reducing poverty and increasing food security. Reductions in poverty and increases in food security can be realized in several ways. One critical aspect to address these issues is the development and adoption of new crop technologies. The process of advancing crop technologies must begin, however, with the identification of the research

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TABLE 1. Bean yield in Africa and Latin America and the Caribbean.

Region	Yield (kg ha^{-1})
Eastern Africa	632
Middle Africa	605
Northern Africa	2,529
Southern Africa	837
Western Africa	587
Central America	726
The Caribbean	764
South America	954

Source: FAO (2014).

priorities that have the highest potential for return on investment (Abdoulaye *et al*., 2014; Creamer *et al*., 2014; Kleinwechter *et al*., 2014; Pemsl *et al*., 2014). Empirical evidence shows that poverty levels would have been 0.4 and 0.1% higher in Rwanda and Uganda, respectively, in the absence of the development and adoption of improved bean varieties. With regard to food security, it was found that, in the absence of bean varietal improvement, food security would have been substantially lower in both countries (Larochelle *et al*., 2013). Likewise, in LAC, gains in yields associated with the adoption of improved bean varieties ranged from 100 kg ha^{-1} in Costa Rica to 350 kg ha^{-1} in Peru (Johnson *et al*., 2003).

Determining the principal constraints that affect this crop and how these constraints vary regionally is an important step in the effort to develop technologies and knowledge to help improve yields, farmer income and food security in LAC and Africa. One of the challenges in prioritizing research associated with the development of new technologies and understanding specific crops is that different locations have the potential to benefit from different technologies. In order to understand if and how priorities for research would vary regionally, a cross-section of bean experts was surveyed to determine what are, in their opinion, the principal constraints and trends for common bean production and commercialization and the priorities for future common bean research.

Although there are quantitative approaches for doing this kind of analysis, such as economic surplus, cost-benefit, and yield gap analyses (Waddington *et al*., 2010), quantitive approaches presuppose a limited number of potenital scenarios based on *a priori* knowledge. In order to open the door to possible new priorities and, likewise, to gain improved understanding of the regional variation needed for bean research, we decided to use a qualitative approach both due to its simplicity and the range of opinions it is possible to gather in a short period of time. Using a qualitative approach, a wide variety of experts can participate in the process, opening the door to valuable information that would be impossible obtain with other approaches (Fuglie, 2007).

Materials and methods

The foundation for this study was a survey that was presented to a number of bean experts throughout the world. The list of bean experts who participated in the survey was compiled from multiple sources in order to ensure representation both in Africa and LAC.

First, we received access to the Pan-Africa Bean Research Alliance (PABRA) database, provided by the International Center for Tropical Agriculture (CIAT) out of their Uganda office. The database includes information regarding the partners working with PABRA and CIAT in the development of technologies and in the delivery of those technologies. The data is updated annually for most countries where activities are implemented regularly. These individuals have had contact with PABRA-CIAT for a period of 5 or more years.

A second list of experts was indentified in cooperation with CIAT researchers based at the CIAT headquarters in Palmira, Colombia. The CIAT bean expert database contains information regarding more than 30 years of work conducted by and in cooperation with the CIAT bean program. Additionally, the survey was also administrated to bean experts who attended the 59th meeting of the *Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos y Animales* (PCCMCA) that took place in Nicaragua between 28 April – 3 May 2014. Finally, names of additional experts were identified through references made by CIAT researchers and, similarly, based on a literature review of experts who have worked on the topics related to the nine categories on which the research options in the survey were classified.

The set of experts came from a broad set of backgrounds and included scientists, crop researchers, university teachers, public and private employees and extension agents. The questionnaire was divided into three sections. In sections A and B, respondents were asked to provide demographic information including their profession and areas of expertise, in which agro-ecological zones their work is focused and what, in their opinion, are the principal constraints in common bean production and commercialization, and the major trend in the next ten years.

Section C asked researchers for their opinions on a list of 97 research options. Those research options were classified into nine categories: crop improvement; production technology, agronomy and crop management; seed systems; disease management practices; pest management; genetic resource management; value chains, post-harvest utilization and other uses; and socio-economic policy and impact studies on the common bean. Survey respondents were asked to share their perspective on the importance of 97 research options for helping to reduce poverty and improve food security using a scoring system of importance (not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, and don't know).

In order to make the survey available to as many bean experts as possible, the questionnaire was made available in four languages: English, Spanish, French, and Portuguese. A total of 123 respondents participated in the survey. The respondents interacted with the survey in two ways; it was administered in person to bean experts at the PCCMCA meeting and it was made available online via the Survey Monkey web page (https://www.surveymonkey.com/) between 19 of May 2014 and 14 of July 2014. All the answers were translated into English and were merged in a single database to facilitate analysis.

Results

Overview of the data

A total of 123 respondents participated in the survey; most of them (88.6%) responded to the survey through the web page www.surveymonkey.com and the remainder (11.4%) responded in person at the 59th meeting of the PCCMCA. The respondents were asked to indicate where their research is focused. In order to geographically classify the research done by the experts, all respondents who indicated expertise associated with issues in a specific country were allocated to the respective geographical region where their country is located.

Since some respondents indicated that their research was focused in several regions of the same continent, each expert was counted only once at the continental scale but could be counted multiple times at the regional level. Finally, the respondents who indicated that their research was focused in several continents were assigned to the global category. Unfortunately, three experts, who indicated that they have a national expertise, didn't indicate in what country their research was focused, so it was not possible to geographically classify them. As shown in Tab. 2, 64 experts indicated that their expertise was focused on Africa, while 30 respondents indicated that their research was focused on the Americas.

TABLE 2. Geographical expertise of researchers surveyed bean.

Location	Total answers
Global	23
Africa	64
Western and Central Africa	17
Eastern Africa	31
South Africa	26
America	30
South America	12
Central America	15
North America	4
Other	3

When the respondents were asked about the importance of bean research in their organization, 62% (76 respondents) answered that the common bean is among the priority crops for their organization; 20% (25 respondents) answered that, in their organization, some research on common bean is done, but it is not a priority crop; 11% (13 respondents) answered that the common bean is the highest ranking priority crop for their organization; while 4% (5 respondents) and 2% (2 respondents) answered that their organization rarely or never conducts research on the common bean and that their organization doesn't carry out research on the common bean, respectively.

Even though common bean research was not a priority crop in many instances, a majority of respondents indicated that the importance of common bean research has increased over the last five years. When asked about the trends associated with common bean research within their organization in the last five years, 50% answered that the amount of research has increased; 29% answered that it has stayed about the same, and 12% answered that it has decreased.

With respect to the respondents' backgrounds, 39% classified themselves as a scientist from a national agricultural research institute, 20% as a research scientist or lecturer at a university, 7% as a research leader or manager from a national agricultural research institute, 7% as a CGIAR center scientist, 4% as a representative of a government organization, 4% as an employee of a private, for-profit organization, 3% as a representative of a non-governmental, not-for-profit organization (NGO), and 3% as an extension agent (Tab. 3).

In order to consider how the respondents' expertise might frame their perspective (*e.g.*, that experts in water management in crop production think that the efficient use of water is the most important priority or that experts in pest management think that pest management is the most relevant priority), the respondents were asked about their disciplinary expertise for a comparison of their areas of expertise and their professional disciplinary areas (Tab. 4).

TABLE 3. Number of respondents by occupation investigating bean.

Profession	Number of respondents	Percentage
Research scientist from a national agricultural research institute	48	39
Research scientist or lecturer at a university	25	20
Other	13	11
Research leader/manager from a national agricultural research institute	9	7
CGIAR center scientist	8	7
Representative of a government organization	5	4
Employed by a private, for-profit company	5	4
Representative of a non-governmental, not-for-profit organization (NGO)	4	3
Extension agent	4	3
No information	2	2

TABLE 4. Disciplinary expertise of respondents.

Topics	Number of answers	Percentage
Plant breeding and conventional genetics	46	16
Crop management, agronomy, and physiology	40	14
Crop disease and management	33	11
Participatory plant breeding	32	11
Crop genetic resources	24	8
Crop pests and management	22	8
Cropping/farming systems	21	7
Post-harvest crop utilization / marketing	17	6
Genomics, bioinformatics, molecular biology	13	4
Economics or policy	13	4
Other	12	4
Soils management	8	3
Water management in crop production	6	2
Climate change specialist	4	1
Transgenic research	2	1

Principal constraints and trends

The respondents were asked what, in their opinion, were the three principal constraints today and the most important trend for common bean production and commercialization in the regions where their research is focused for the coming decade. Approximately 16% of the respondents indicated that diseases were the principal constraint. Diseases most mentioned include leaf spot (*Pseudocercospora griseola* (*Sacc.*) Crous & Braun), common bacterial blight (*Xanthomonas axonopodis* pv. phaseoli (Smith)), anthracnose (*Colletotrichum lindemuthianum* (Sacc. and Magn.) Bri. and Cavi.), and some diseases of the roots, such as bean root rot (*Rhizoctonia solani* AG 2-2, *Pythium* sp. and *Fusarium solani*) (Fig. 1).

According to 11% of the respondents, pests are the second principal constraint; followed by market constraints (11%), such as: access to and the high cost of inputs; the low prices received by farmers, the appropriation of a large percentage of profits by dealers, lack of credit, lack of market access, price instability. Issues related to extension and production technologies (EPT) such as low rates of technology adoption, limited technical assistance to farmers, and poor agronomic practices, are also seen as important constraints (Fig. 1).

Respondent opinions suggested an expectation for increases in demand and production over the next ten years. The expected increase in demand was attributed mainly to the expected rise in the cost of other sources of proteins and the popularization of bean-based products (such as ready-to-eat preparations). Respondents anticipated the development and greater adoption of improved bean varieties with tolerances to the most important biotic and abiotic stresses that affect common bean production and commercialization. Likewise, the respondents expected that improvement in bean nutritional quality will be a principal trend (Fig. 2).

Importance of the research options

Understanding the constraints and trends associated with bean production and commercialization provides context for understanding potential research priorities. In section C of the survey, the respondents were asked to assess the importance of 97 research options on a scale of 1 (not important) to 5 (most important). Since every region has different constraints and needs, and experts from different areas may have different perceptions (*i.e.*, perspectives based on regional need or disciplinary-specific biases), the results of the perceived research priorities (highest average perceptions) are presented by regions and disciplines in Tabs. 5 and 6, respectively.

Taking into consideration the cross-section of opinions, the survey yielded several research options priorities. These options included: the development of drought tolerant varieties and water use efficiency; breading for consumer

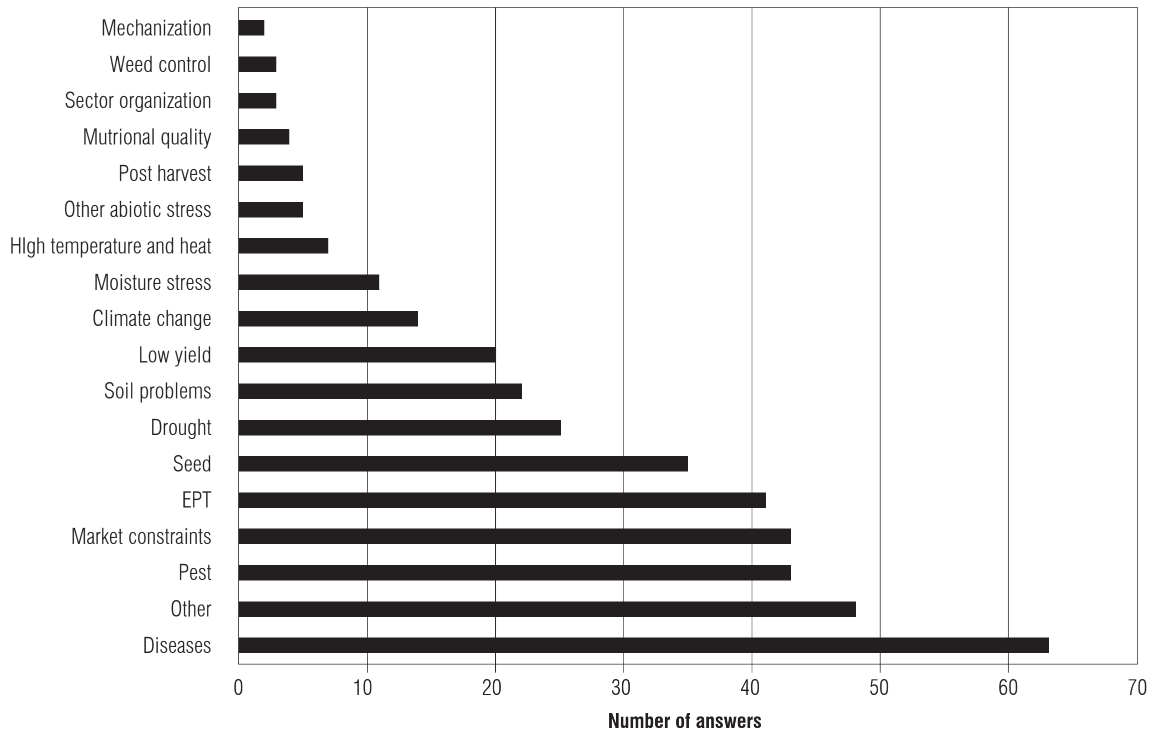

FIGURE 1. Principal constraints for common bean production and commercialization.

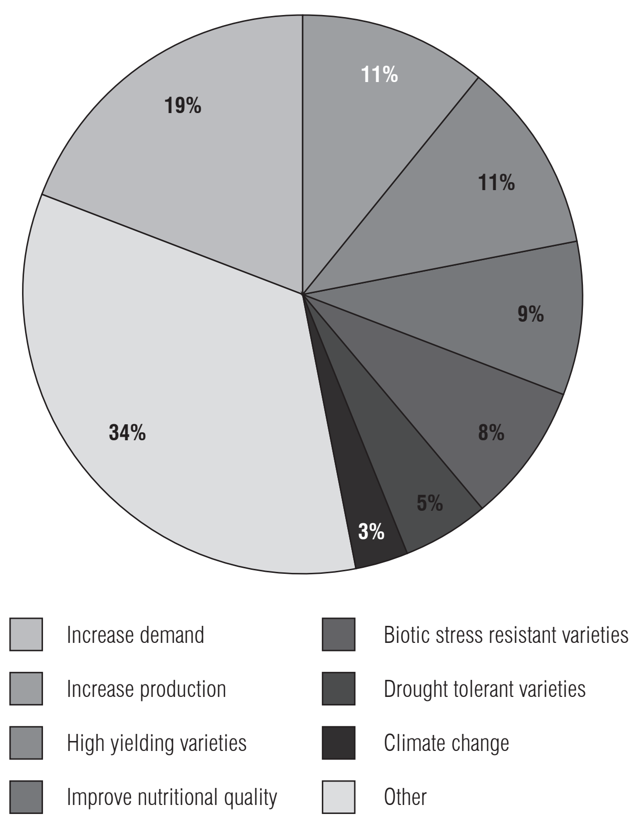

FIGURE 2. Principal trends for common bean production and commercialization.

acceptance (improved cooking time and desired texture after cooking); and breeding for high yield. Additionally, the research suggested that institutional measures are needed, such as improving formal seed production and distribution channels and the development of national and regional seed policies (Tab. 5).

As was expected, there were differences between the perceived importance of the research priorities between regions. In the case of LAC, the results indicated that the development of varieties resistant to high temperatures is one of the most important research priorities. However, when the regions were aggregated, the priority of resistance to high temperatures is lowered. Similar variation in priorities across regions was evidenced with respect to the management of the whitefly as a priority in LAC and to the management of the bean stem maggot (*Ophiomyia* sp.) as a key priority in Africa.

The experts who characterized their research as global indicated that the highest research priority is the development of varieties resistant to the common mosaic virus, followed by breading for consumer acceptance (improved cooking time and desired texture after cooking); breading for drought tolerance and water use efficiency; phenotypic molecular screening of landraces in search of high value traits for new sources of tolerance/resistance to stress; and

TABLE 5. Highest ranked common bean research option by geographic expertise.

Research option	Category	LAC	Africa	Global	All
Drought tolerance / water use efficiency	BASR	**4.35**	**4.52**	**4.59**	4.49
Consumers acceptance (cooking time / texture after cooking)	VCPHU	4.00	**4.52**	**4.65**	4.41
Breeding for high yield	CP	**4.27**	4.39	**4.46**	4.39
Improving production and distribution of seeds (formal)	SS	4.12	**4.50**	4.29	4.36
National and regional seed policies	SS	**4.20**	4.39	4.22	4.32
Phenotypic molecular screening of landraces in search of high value traits for new sources of tolerance/resistance to stress	GR	**4.16**	4.26	**4.50**	4.30
Linking farmers to markets	VCPHU	4.00	**4.52**	4.24	4.27
Improving technologies for farmer-based production and distribution of seeds (informal)	SS	3.96	4.38	4.33	4.19
Assessment of common bean technology adoption	SEPI	3.96	4.40	4.05	4.14
Assessment of small farmer access to new technologies	SEPI	3.79	4.33	4.19	4.13
Collection characterization and evaluation documentation (*ex situ*)	GR	**4.15**	4.15	3.94	4.09
Market studies	SEPI	3.65	**4.44**	3.82	4.05
Bean stem maggot (*Ophiomyia* sp.)	PM	3.05	**4.44**	**4.46**	4.03
Bean common mosaic virus	BBSR	3.52	3.98	**4.67**	3.98
Anthracnose (*C. lindemthianum*)	DMP	3.81	4.00	3.94	3.94
High temperature	BASR	4.12	3.68	4.05	3.91
Common bacterial blight (*X. axonopodis*)	DMP	3.62	3.98	4.00	3.89
Whitefly	PM	4.05	3.38	3.73	3.59

Source: Authors' calculation. CP, crop improvement; BBSR, breeding for biotic stress resistance; BASR, breeding for abiotic stress resistance; SS, seed systems; PM, pest management; GR, genetic resource management; VCPHU, value chains, post-harvest utilization and other uses; SEPI, socio-economic, policy and impact studies on the common bean. Top ranked research option in each region in bold.

finally, breeding for high yield. Interestingly, the development of varieties resistant to the common mosaic virus was not among the top five research priorities for experts from either Africa or LAC.

As with all surveys, there was a potential for introduced bias as a function of the respondents' backgrounds. While the ranking of specific priorities varied among the experts in different areas, the overall results indicated that the experts across all of the surveyed disciplines had similar perceptions of the principal research priorities. For instance, consumer acceptance (cooking time/texture after cooking) was among the most highly-valued research options, regardless of discipline. Likewise, breeding for drought tolerance and water use efficiency was among the highly-valued research priorities in seven of the eight analyzed disciplines (Tab. 6).

However, in certain cases, there was evidence of biases introduced by the respondents' backgrounds; for instance, experts in crop genetic resources and cropping farming system were the only ones who included germplasm enhancement and pre-breeding and managing crop residues, respectively, into their research priorities. Since, in general, experts of all the disciplines had similar perceptions of most of the research priorities, it was concluded that the respondents' expertise did not introduce any important biases into the results (Tab. 6).

The fact that breeding for drought tolerance and water use efficiency was the highest valued research option reflects the overarching concern for drought in Latin America, the Caribbean and Africa. Specifically, it is estimated that 4 million ha are affected by this specific abiotic stress in these regions (Cortés *et al*., 2013). The major bean producing areas where drought is a significant constraint include: the semiarid highlands of Mexico, the Central America Pacific coast, northeast Brazil, and a substantial portion of eastern and southern Africa (Rao *et al*., 2013).

In beans, drought can lead to poor grain filling, reduction in the number of seeds per pod, and a reduction in the length of the pods, consequently lowering both yield and bean quality (López *et al*., 2008). Estimates for potential declines in yields due to drought range from a low value of 22% to a high of 71% (Ramirez-Vallejo and Kelly, 1998). The negative effects of drought on yields and seed quality depend on several factors, such as duration of drought, the affected genotype, the capacity of the soil to store moisture, and the atmospheric conditions that affect rates of evapotranspiration (López *et al*., 2008).

Conclusions

The main objective of this article is to identify the principal constraints and trends in common bean production and commercialization, as well as priorities for future common

TABLE 6. Highest ranked common bean research option by discipline expertise.

Research option	Category	CDM	CGR	CMAP	CPM	PPB	CFS	PBCG	PHCU
Breeding for high yield	CP	**4.41**	**4.39**	4.35	**4.38**	4.25	4.52	**4.38**	4.35
Improving production and distribution of seeds (formal)	SS	**4.19**	3.95	**4.52**	**4.38**	4.25	4.53	**4.35**	**4.64**
Drought tolerance/water use efficiency	BASR	**4.25**	**4.61**	**4.54**	4.29	**4.40**	**4.67**	**4.33**	**4.73**
Consumer acceptance (cooking time/texture after cooking)	VCPHU	**4.23**	**4.33**	**4.41**	**4.33**	**4.43**	**4.59**	**4.33**	**4.64**
Phenotypic molecular screening of landraces in search of high value traits for new sources of tolerance/resistance to stress	GR	**4.36**	**4.40**	4.39	4.19	4.19	4.25	**4.28**	4.50
National and regional seed policies	SS	4.04	3.79	4.29	4.30	4.26	4.53	4.24	**4.64**
Assessment of common bean technology adoption	SEPI	4.03	3.95	4.21	4.19	4.19	4.53	4.14	4.57
Breeding for other consumer preferred traits	CP	4.00	4.00	4.14	4.00	4.19	3.95	4.11	4.06
Collection characterization evaluation documentation (*ex situ*)	GR	4.00	4.14	4.06	4.00	4.11	4.06	4.10	4.23
Linking farmers to markets	VCPHU	4.10	3.95	**4.41**	4.24	**4.36**	**4.65**	4.05	**4.79**
Assessment of small farmer access to new technologies	SEPI	4.00	3.95	4.33	4.14	**4.27**	4.41	4.00	4.50
Improving technologies for farmer-based production and distribution of seeds (informal)	SS	4.10	4.05	4.27	**4.43**	**4.36**	**4.59**	3.98	4.43
Early harvest	BGH	3.97	3.71	4.13	**4.33**	3.79	4.33	3.93	4.57
Anthracnose (*C. lindemuthianum*)	BBSR	4.16	3.76	4.27	4.05	3.60	4.32	3.87	4.36
Germplasm enhancement and pre- breeding	OO	3.90	**4.29**	4.23	4.15	4.00	4.21	3.86	4.39
Angular leaf spot (*P. griseola*)	BBSR	4.13	3.86	4.09	4.24	4.07	4.16	3.84	4.44
Market studies	SEPI	3.93	3.78	4.24	4.24	4.08	**4.65**	3.83	**4.71**
Common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*)	BBSR	3.87	4.00	4.16	4.05	3.60	4.17	3.71	4.38
Bean common mosaic virus	BBSR	3.94	4.05	4.12	4.05	3.80	4.05	3.70	4.36
Improving soil fertility fertilizer application	PTACM	3.94	3.71	4.18	4.05	3.85	**4.75**	3.68	**4.79**
Bean stem maggot *Ophiomyia* sp.	PM	3.81	4.07	**4.44**	**4.35**	4.16	4.47	3.66	4.57
Managing crop residues	PTACM	3.69	3.46	4.09	3.95	3.76	**4.59**	3.53	4.27

Source: Authors' calculation. CP, crop improvement; BBSR, breeding for biotic stress resistance; BASR, breeding for abiotic stress resistance; SS, seed systems; PM, pest management; GR, genetic resource management; VCPHU, value chains, post-harvest utilization and other uses; SEPI, socio-economic, policy and impact studies on the common bean; OO, other opportunities for crop improvement; PTACM, production technology, agronomy, crop management; CMAP, crop management, agronomy, and physiology; CFS, cropping/farming systems; CGR, crop genetic resources; CPM, crop pests and their management; PBCG, plant breeding and conventional genetics; PPB, participatory plant breeding; CDM, crop diseases and their management; PHCU, post-harvest crop utilization/marketing. Top ranked research option in each category in bold.

bean research in Africa and LAC. In order to do so, a survey was administered to 123 experts with diverse backgrounds and expertise.

The principal constraints that face common bean production and commercialization include both diseases and pests. The diseases, including angular leaf spot (*P. griseola*), common bacterial blight (*X. axonopodis*), anthracnose (*C. lindemuthianum*), and some diseases of the roots such as bean root rot (*R. solani*, *Pythium* sp. and *F. solani*), vary widely in terms of their geography. Pests, on the other hand, tend to be much more geographically specific. For example, the whitefly is a priority in LAC and the management of the bean stem maggot (*Ophiomyia* sp.) is a key priority in Africa.

The respondent opinions suggested a strong expectation for increases in demand and production over the next ten years. The expected increase in demand is attributed mainly to the expected rise in the cost of other sources of proteins and the popularization of bean-based products (such as ready-to-eat preparations). The respondents anticipated the development and greater adoption of improved bean varieties with tolerances to the most important biotic and abiotic stresses that affect common bean production and commercialization. Likewise, the respondents expected that improvement in bean nutritional quality will be a principal trend.

Taking into consideration the cross-section of opinions, the survey yielded several research option priorities. These options include breeding and selecting for several traits such as drought tolerance and water use efficiency, improved yields, and consumer acceptance (improved cooking time and desired texture after cooking). Additionally, the research suggested that institutional measures are needed, such as improving formal seed production and distribution channels and the development of national and regional seed policies.

As was expected, there were differences between the perceived importance of the research priorities between the regions. In the case of LAC, the results indicated that the development of varieties resistant to high temperatures is one of the most important research priorities. However, when the regions were aggregated, the priority of resistance to high temperatures was lowered. Similar variation in priorities across regions was evidenced with respect to the management of the whitefly as a priority in LAC and the management of the bean stem maggot (*Ophiomyia* sp.) as a key priority in Africa.

In contrast to the regional perspectives, the experts who characterized their research as global indicated that the development of varieties resistant to the common mosaic virus is among the highest research priorities. Interestingly, this option was not among the top five research priorities for experts from either Africa or LAC.

As with all surveys, there was a potential for introduced bias as a function of the respondents' backgrounds. While the ranking of specific priorities varied among the experts in different areas, the overall results indicated that the experts across all of the surveyed disciplines had similar perceptions of the principal research priorities.

In fact, the regional bias as evidenced above may be one of the most important findings of this effort. As the prioritization process is expanded to include Asia, we believe there will be additional insights to be gained in terms of understanding the overall system of bean production and consumption.

The common bean remains an important crop in LAC and Africa. This crop is affected by many biotic and abiotic stresses, many of which have the potential be exacerbated by the effects of climate change. The development of a research agenda to address the constraints and trends identified in this survey can help to increase bean yields, farmer incomes and food security in many regions throughout the world.

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