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Potential adoption and impact of Embrapa 5.1 GM common bean for small and middle size farms in Brazil

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Abstract
Brazil is the largest common bean (*Phaseolus vulgaris* L.) producer and consumer worldwide. Main commercial grain type is "carioca" bean, the country's main dry bean class, is virtually all produced and consumed in Brazil. Over 90% of producers grow beans on less than 5 hectares. The Bean Golden Mosaic Virus (BGMV) is regarded as a major disease in common bean production in Brazil as well as in other countries. The control of the vector white fly (*Bemisia* spp.) demands a large amount of insecticides. In September 15, 2011, an official Brazilian authority institution approved the commercial release of the first trait of genetically modified common beans. This trait represents a milestone in genetically modified organisms (GMO), since this is the first GM trait developed by public research in Brazil, supported exclusively by public fundings, and whose focus is on a crop that is grown mainly by small and medium size farms in Brazil. The 'Embrapa 5.1' GM trait incorporates a genetic resistance against the BGMV. In order to obtain the GM varieties, the Embrapa 5.1 trait must be incorporated into breeding lines. Now, the unsuitable areas highly infested by the white fly may become suitable again for growing dry beans. The first seeds of GM bean varieties are expected to be available to farmers in Brazil by 2015. Thus, we consulted experts to assess the potential changes in the dry common bean chain after the commercial release of GM bean varieties to seed and grain producers in Brazil. The consultation was undertaken via telephone interview plus + questionnaire with agronomic consultants, seed producers and bean processors during 1st semester 2012. In general, it is expected that (a) bean production will return to those BGMV infected areas; (b) production costs will be reduced (less pesticide use); (c) grain quality may improve due to less potential pesticide residues; (d) production may become more constant over the year, reducing price fluctuations; and (e) consumers will have access to cheaper food throughout the year.
Key words: green biotechnology, disease resistance, ex-ante evaluation

Introduction

Brazil is the largest common bean (*Phaseolus vulgaris* L.) producer and consumer worldwide. Main commercial grain type is "carioca" bean, the country's main dry bean class, is virtually all produced and consumed in Brazil. Over 90% of producers grow beans on less than 5 hectares (Silva & Wander, 2013).

The Bean Golden Mosaic Virus (BGMV) is regarded as a major disease in common bean production in Brazil as well as in other countries. The control of the vector white fly (*Bemisia* spp.) demands a large amount of insecticides.

In September 15, 2011, the official Brazilian authority approved the commercial release of the first trait of genetically modified common beans (CTNBio, 2011). This trait represents a milestone in genetically modified organisms (GMO), since this is the first GM trait developed by public research in Brazil, supported exclusively by public fundings, and whose focus is on a crop

that is grown mainly by small and medium size farms in Brazil. The 'Embrapa 5.1' GM trait incorporates a genetic resistance against the BGMV.
In order to obtain the GM varieties, the Embrapa 5.1 trait must be incorporated into breeding lines. Nowadays, the unsuitable areas highly infested by the white fly may become suitable again for growing dry beans. The first seeds of GM bean varieties are expected to be available to farmers in Brazil by 2015.
During the biosafety analysis phase of the technology, a consultation workshop of stakeholders evidenced an information asymmetry among different interest groups (GUIVANT et al., 2009). Since genetic modified organisms (GMOs) represent a controversial technology, advances in information to stakeholders seem to be of crucial importance, in order to provide the basis of any kind of discussions in favor or against it.
So far, not all possible commercial implications of a market introduction of GM bean varieties are known. Thus, a survey with experts was carried out to assess the potential changes in the dry common bean chain after the commercial release of GM bean varieties to seed and grain producers in Brazil.

Material and Methods
The expert consultation was done via electronic questionnaire and telephone interviews. First, all experts were contacted by phone explaining the consultation. In a second step, the questionnaire was administered either via email or telephone to agronomic consultants, seed producers and bean processors from different regions of Brazil during the first half of 2012.
Figure 1 shows the main agents of the common bean chain in Brazil. The interviewed experts belong to the first three chain steps (input/seed providers, consultants and producers, and bean processors). Thus, the expected impacts represent the point of view of three interest groups only.

Figure 1: Basic common bean chain in Brazil.

The questionnaire was sent to 30 experts and 11 responses were received from the states of Paraná, Minas Gerais, São Paulo and Goiás. Those are the main common bean producing states in Brazil. All responses were grouped into categories, which were qualitatively analyzed.

Results and Discussion
Input providers believe that the release of GM bean varieties will generate additional market for other inputs (fertilizers and pesticides), but will reduce the market for insecticides, since white fly population will not need a strong control anymore (Table 1).
At bean production level, there are the most expected positive changes: (a) a better production stability due to lower risks of losses; (b) lower production costs in areas with white fly infestations; (c) less pesticide use; (d) possibility to grow beans again in about 200 thousand hectares with high white fly infestation; (e) the possibility to grow beans throughout the year in tropical regions, reducing supply and price volatility; (f) increased flexibility to sow at specific dates to better explore market opportunities; and (g) low royalties since R&D was all public. However, there are some uncertainties related to possible consumer behavior against GMO as well as market saturation (lower prices) (Table 1).

Table 1: Expected changes in the common bean chain in Brazil after the release of GM varieties into the market from the producers and input/seed providers point of view.

Chain level	Expected changes from chain agents' perspective	
	Positive effects	Negative effects
Input providers	☑ Additional market for other inputs (fertilizers and pesticides).	☒ Market reduction for white fly (vector) population control insecticides.
Bean producers	☑ Better production stability (lower production risks); ☑ Lower production costs in areas with white fly infestations; ☑ Less pesticide use; ☑ Possibility of expanding the cultivated area (~200,000 hectares with cultivation limitation because of white fly infestation); ☑ Ability to grow beans throughout the year in tropical regions => improved market supply and less price fluctuation; ☑ Flexibility (expansion of sowing windows => opportunity to explore market opportunities); ☑ Low royalties (public R&D).	☒ Market uncertainty (if consumers reject GM products); ☒ Higher production possibilities may increase production (market saturation => prices may fall).
Elevators (cleaning, classifying & packing)	☑ Better bean quality (less pesticide use); ☑ Lower acquisition prices because of higher and more constant bean production and supply over the year.	☒ Selling price may fall in cases of oversupply; ☒ Market uncertainty (if consumers reject GM products).
Distribution channels (wholesalers & retailers)	☑ Lower acquisition prices due to constant bean production and supply over the year; ☑ Stocks may be reduced (lower costs) because of more constant supply; ☑ Opportunity to offer a better quality product to consumer (less insecticide residues) at reasonable prices.	☒ Consumers may have restrictions to GM bean.
Bean consumers	☑ Better quality (less insecticide residues) (choice option); ☑ Less price peaks over the year; ☑ Lower average prices.	☒ None.

Source: Field research.

For elevators, who clean, classify and pack the dry common beans, a better quality (less pesticide use) and lower acquisition prices are expected, since production is expected to be more constant all over the year. However, if market is saturated, their selling price may fall and there is some market uncertainty, if consumers reject the GM beans.

Distribution channels are expected to benefit from lower acquisition prices; they may reduce stocks since it is expected to be more constant production over the whole year, and the opportunity to have a high quality product with less potential risk of pesticide residues. However, there are some uncertainties related to the acceptance of GM beans by consumers.

Bean consumers are expected to have only benefits, including higher quality (less pesticide use), lower prices with less fluctuation over the year.

Conclusions and Outlook

In general, it is expected that (a) bean production will return on those BGMV infected areas; (b) production costs will be reduced (less pesticide use); (c) grain quality may improve due to less potential pesticide residues; (d) production may become more constant over the year, reducing price fluctuations; and (e) consumers will have access to cheaper food throughout the year.

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References

COMISSÃO TÉCNICA NACIONAL DE BIOSSEGURANÇA (CTNBIO). (2011). Extrato de Parecer Nº 3024/2011. Online available at <http://www.ctnbio.gov.br/upd_blob/0001/1588.doc>. Accessed on April 02, 2013.

GUIVANT, J.S., CAPALBO, D.M.F., DUSI, A.N., FONTES, E.M.G., PIRES, C.S.S. AND WANDER, A.E. (2009). Uma experiência de consulta a setores de interesse no caso do feijão transgênico. In: COSTA, M.A.F.D. AND COSTA, M.D.F.B.D. Biossegurança de OGM: Uma visão integrada. Biossegurança de OGMs, Vol. 1. Publit, Rio de Janeiro, RJ, Brazil. p.158-189.

SILVA, O.F. AND WANDER, A.E. (2013). O feijão-comum no Brasil: passado, presente e futuro. Documentos / Embrapa Arroz e Feijão. Vol. 287. Embrapa Arroz e Feijão, Santo Antônio de Goiás, GO, Brazil.