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Status of market, regulation and research of genetically modified crops in Chile

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ABSTRACT

Agricultural biotechnology and genetically modified (GM) crops are effective tools to substantially increase productivity, quality, and environmental sustainability in agricultural farming. Furthermore, they may contribute to improving the nutritional content of crops, addressing needs related to public health. Chile has become one of the most important global players for GM seed production for counter-season markets and research purposes. It has a comprehensive regulatory framework to carry out this activity, while at the same time there are numerous regulations from different agencies addressing several aspects related to GM crops. Despite imports of GM food/feed or ingredients for the food industry being allowed without restrictions, Chilean farmers are not using GM seeds for farming purposes because of a lack of clear guidelines. Chile is in a rather contradictory situation about GM crops. The country has invested considerable resources to fund research and development on GM crops, but the lack of clarity in the current regulatory situation precludes the use of such research to develop new products for Chilean farmers. Meanwhile, a larger scientific capacity regarding GM crop research continues to build up in the country. The present study maps and analyses the current regulatory environment for research and production of GM crops in Chile, providing an updated overview of the current status of GM seeds production, research and regulatory issues.

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Introduction

Genetically Modified (GM) crops are those organisms that have been modified by the application of recombinant DNA technology or genetic engineering. These crops have been the most rapidly adopted agricultural technology in mankind's history, as evidenced by a 100-fold increase from 1.7 to 179.7 million hectares globally

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cultivated between 1996 and 2015 [1]. At the worldwide level, a small number of GM crops have been developed and released for commercial agricultural production. They include insect resistant cotton, maize, soybean and eggplant, herbicide tolerant soybean, cotton canola, maize, alfalfa and sugar beet, and viral disease resistant papaya and squash [1,2]. New crops and traits have achieved regulatory approval in specific countries, including the virus resistant bean in Brazil [3] and non-browning apple in the USA [4]. In addition, there is an increasing number of GM crops under development and not yet commercially released with traits encoding either abiotic stress tolerance or biofortification [5,6]. The environmental and economic impacts of this technology for farmers, farm workers, countries and society have been extensively reported elsewhere [7,8].

Chile is recognised for its fresh fruit, wine and seed exports and has turned food production into a global business, emerging as a key food exporter for markets in North America, Europe and Asia [9]. Globally, Chile is the 5th largest exporter of seeds in terms of value, reaching US$388 million in 2012 [10]. Subsequently, the country has become the main exporter of GM seeds from the Southern Hemisphere in order to supply counter-season markets in the Northern Hemisphere [11]. Several private companies have invested heavily in winter nurseries and research programmes for GM seeds over the last ten-years in Chile due to its singular geographic and weather conditions along with regulatory and political stability. Thus, breeders in the Northern Hemisphere, while they are in winter, can speed up their research programmes sending GM seeds for field evaluations. This leads to the development of the next generation of crops in a shorter period of time [1].

Both GM seed production and R&D activities must comply with a strict regulatory framework in Chile. However, in terms of GM crops, the country has a rather confusing scenario. The regulatory framework allows GM seed production exclusively for export and R&D activities, yet those seeds are not allowed to remain in the country. At the same time, although some rules related to GM food/feed have been issued, they are not in place and there are no restrictions for imports of GM food or feed. In spite of this confusing scenario, aware of the key role that biotechnology could play as a factor of competitiveness, in 2001 the Chilean government launched the "Programme for Biotechnology Development in the Forestry, Agricultural, and Aquacultural Sectors". In 2003, a National Policy for the Development of Biotechnology was designed [12]. In the area of crop biotechnology these policies have encouraged initiatives from Universities and the public sector regarding plant tissue culture and the use of molecular markers for the identification and characterisation of agricultural and forestry species. In regard to GM crops, public research efforts have achieved the genetic transformation of potatoes in order to develop traits encoding either virus or disease resistance. Similar efforts have been extended to several other species relevant to Chile's economy, such as table grapes, cherries, peaches, apples and melons. Field testing of herbicide-tolerant sugar beet, which allows for reduced production costs and thus increases their competitiveness in the marketplace, has also been carried out.

In this study we offer an updated overview of the current GM crop situation in Chile in terms of research investments, economic impacts and regulatory policies.

Production and trade

Located in the Southern Hemisphere and extending from latitude 17° to 56°S, a variety of climates can be found in Chile, from desert in the North, to Mediterranean in the center and cool and damp in South. Thus, Chile is ideally suited for counter-season activities for Northern Hemisphere locations.

Chile has become one of the most important players in the world for production of seed on a regular basis and for the offseason production (GM and non-GM) for other regions. Its advantages include clear, science-based rules and regulations for GM seed production and R&D activities, expedited import and export procedures, excellent scientific and technological capacity, good correlation with environments in North America and Europe, facilitating effective selection for important traits, well developed infrastructure for ease of transportation and communications, political and economic stability, and free trade agreements with all major markets. It currently ranks fifth among countries exporting seeds worldwide, and ranks first in exports of GM seeds in the Southern Hemisphere [10]. GM seeds produced in Chile are exported primarily to the USA [13].

In this context, Chile has multiplied GM seeds under stringent field controls for re-export for more than two decades. However, field trials with GM crops have been carried out since 1987, when the first environmental release was authorised [14]. Through the years, the main GM seeds produced in Chile have been maize, canola and soybean (Fig. 1). Other GM plant species have been sown at a considerably lower level [15]. Field trials have involved maize, canola, soybean, safflower, tomato, sugar beet, mustard,

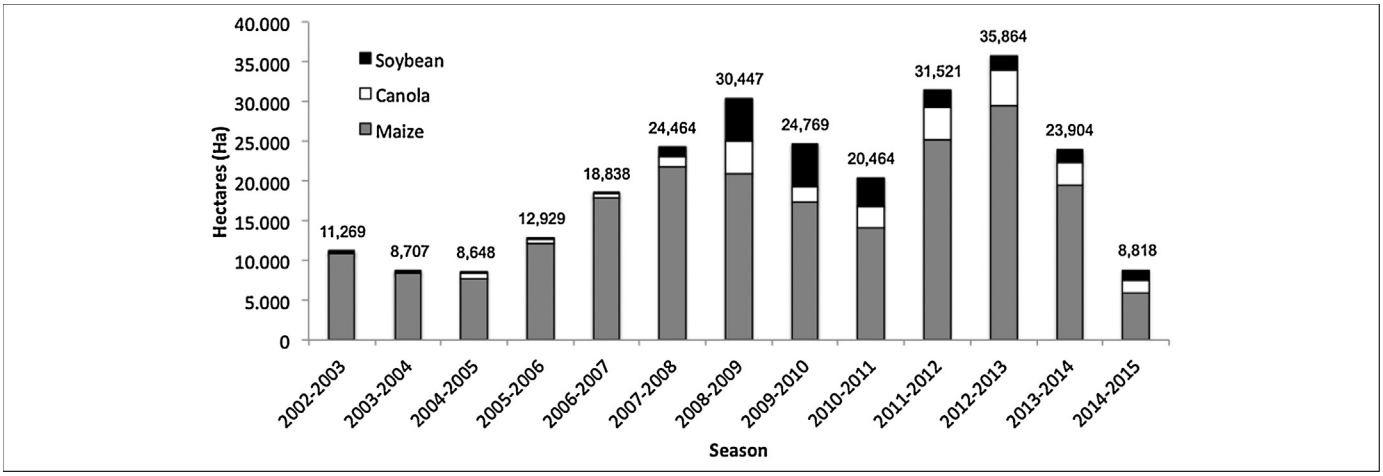

Fig. 1. GM seeds produced in Chile.
The three main GM seeds sown in the country are shown. Other GM seeds are safflower, tomato, sugar beet, mustard, rice, table grape, cotton and squash. The number of total hectares per season with GM seeds is shown. Chart was elaborated from data obtained from SAG 2015.