

(1) Chilean Seed Industry
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(2) Chile is a long and narrow country located between parallels 17° 30' and 56° 30' latitude S, at the southwest edge of South America. There are three countries that have borders with Chile: Argentina, at the east, Bolivia at the north-east, and Peru at the north.

(3) Because of its length and geography, Chile has a great variation in agro-climatic conditions. The average temperature, for example, decreases from north to south. (4) In contrast, the average rainfall increases from almost nothing in the extreme north to greater than 1500 mm/year in some areas of the south. (5) As a result of these variations, the country can be divided into three well-defined geographic and climatic zones: 1) North, with a hot and dry climate, 2) Central, mediterranean climate with mild, wet winters and long, dry summers, and 3) South, with a maritime climate, colder and humid, with rainfall during almost the entire year, mainly in the fall and winter.

(6) In addition to the climatic differences from north to south, each zone of the country has important east to west variations. For example, in the north there are four topographical zones illustrated in this figure. The Andes Mountain Range in the east is the natural border with Bolivia and Argentina. More to the west, there is a second Chain of Mountains, lower than the Andes. The water that flows from the Andes to the west is trapped by this second chain of mountains, which causes salt and mineral accumulation from the world's largest copper mines between the two sets of mountains. (7) Continuing to the west, the lack of water flowing from the Andes and the absence of rains creates the Atacama Desert, the driest desert in the world. Under these conditions, (8) agriculture is restricted to oases and small valleys. Historically, this area has been used for production of olives and early season vegetables, which are sold at higher prices in the large cities of the central zone. (9) Here, one can see production of sweet corn and tomato crops during the winter in two valleys located in the extreme northern portion of Chile.

(10) Recently, some seed companies have considered the possibility of seed production in this region. For example, here are facilities used to produce seeds of solanaceous species. Seed production is performed under large fine white net cages that allow plant isolation from insects that could cause pollen contamination and disease transmission. (11) Under these conditions, the use of water must be highly efficient; in this case, drip irrigation is used along the plant rows. Despite practical difficulties in producing seed in this area, there are important advantages such as isolation and the ability to produce a seed crop throughout the entire year. (12) This is an important point for Chilean seed producers, because it gives them more flexibility and the ability to offer better service as contract producers, which is important in today's global and competitive seed business. This image demonstrates harvesting and planting operations occurring at the same time during late winter in the Azapa valley.

(13) Remaining in the north zone, but more to the south of the Atacama desert, the second chain of mountains starts to disappear and the existence of valleys becomes more frequent. In these areas, agriculture becomes an important economic activity, with production of fruits such as table grape, citrus species and papaya. The production of early season vegetables and flowers is also significant.

(14) The central zone also has four topographical zones from west to east: 1) The Andes Mountain Range in the east, 2) a central plain, 3) a Coastal chain of mountains that are not as high as the Andes, and 4) the shore of the Pacific Ocean. In the Central Zone, the plain forms the Central Valley, which is approximately 650 miles long and 25 to 50 miles wide. This is the most densely populated area of the country and the most productive agricultural zone, with almost 40% of the country's arable land.

(15) Santiago, the capital and most important city in Chile, is located in this area at the base of the Andes. There are around 5 million people living in Santiago, which represents almost a third of the Chilean population.

(16) The Central Valley has exceptional conditions for agriculture, such as fertile soil, good weather and ready availability of water for irrigation. Most of the intensive agriculture of the country occurs in this region. Some of the most important species produced are 1) table and wine grapes, 2) fruits, mainly for export, such as apples, peaches, pears, plums, and cherries, 3) cereals such as corn and wheat, 4) a diversity of vegetables, 5) flowers, and 6) seeds.

(17) Because this area has a Mediterranean climate with long and dry summers, irrigation is a fundamental requirement for successful agriculture. The Andes Mountains provide a natural reservoir of water. In addition, there are several dams built to store water during higher demand months. In Chile, over 22,800 km of irrigation channels exist, providing water to an area greater than 1 million hectares.

(18) The Central Valley of the Central zone is where most Chilean seed production occurs. The absence of rains during summer reduces disease development during seed production, (19) and also provides ideal conditions for plant maturity and (20) seed desiccation for the production of high quality seeds.

(21) In addition, the existence of a winter season, (22) allows the production of winter species (23) requiring vernalization for flowering (24) of some crops such as carrots and many onion and beet species.(25)

(26) In the south zone, the growing season becomes shorter because of lower temperatures and, along with less irrigation infrastructure, restricts the types of agriculture that can be performed in this area. Common agriculture in this zone includes wheat, dairy and cattle, potatoes, sugar beet, some vegetables and forestry.

(27) The zone is characterized by the presence of lakes, volcanoes and native forests, (28) which is excellent for tourism, but not intensive agriculture. (29) Examples of agricultural production in the extreme south are salmon and lambs for wool.

(30) SEED PRODUCTION

Seed production in Chile can be grouped into two types: 1) seed crops for the national market and 2) seed crops for export. Crops such as wheat, beans, rice, forage and others

are produced for the internal market and are certified by the national Agriculture and Livestock Services (SAG). But, there is also a significant amount of seed produced without certification for internal use by farmers or for sale in the informal market.

(31) In this Table, the Chilean seed market value is low relative to values in other countries. With an estimated value of 120 million dollars, the Chilean seed market ranks 31st, well below other South American countries such as Brazil and Argentina.

(32) On the other hand, when the value of seed exports is compared, Chile ranks eighth, and it is the most important seed exporter among the countries in the Southern Hemisphere.

The Chilean seed production for international markets consists of 1) producers that contract with companies that develop and/or trade the seed and 2) companies that have their own production and trials. Over 90% of the seeds produced under these conditions are exported in bulk where they can be repackaged in the importing country and exported to a third country for sale. The remaining 10% is packaged in Chile under international guidelines and exported primarily to South American countries.

(33) Recently, approximately 70 companies produce seeds for export in Chile. This Table shows the number of companies by crop from 1997 to 2004. Many of these companies produce seed of differing crops. From the 71 companies that produced seed for export during 2004, 15 produced 86% of the total exported value for that year.

(34) According to the last agricultural census performed in 1997, there were 3,066 growers dedicated to seed production on a total of 29,778 hectares, with over 65% of them oriented to seed exports. As shown in this Table, the average area of each grower is variable and depends on the crop. For example, the average area for maize seed production was 20 hectares, while for vegetables the average area was 2.9 hectares.

(35) Most seed production in Chile is concentrated in the Central Zone with a slight tendency for vegetable and flower seed crops to be produced in the north and maize and sunflower crops to be produced in the south. Certain types of seed crops, such as forage species, are produced primarily in the south. The favorable climatic conditions and high technical level of growers in the Central Zone result in excellent yields and high quality seeds. For farmers involved in seed production, the activity has improved their incomes, in addition to creating the challenge and need to raise their technological seed production expertise. In general, seed production requires qualified personnel, higher salaries, and has become an attractive work alternative for people in the rural zones of the country, thus having an important social and economic impact for the country.

(36) As seen in this figure, in the last 15 years, Chilean seed exports have experienced significant growth from less than 30 million dollars in 1990 to over 170 million dollars in 2005. As a result, Chile is one of the most important seed exporters in the world. (37) This position is a result of several comparative and competitive advantages. Among them:

- Counter-season production compared to the northern hemisphere, where most of the major seed companies are based. This allows the acceleration of breeding cycles as well as prevention from seasonal hazards due to local climatic stresses.
- Presence of different agro-climatic zones along the country, which allow the production of a wide number of species.
- Well-marked seasons during the year with an absence of summer rains that is important for the production of high quality seeds.
- Low incidence of phytosanitary problems that affect seed quality. Along with the dry summers and favorable conditions for seed maturation and desiccation, the natural Chilean geographical boundaries (the Andes in the east, the desert in the north and the ocean at the west and south) are barriers preventing the entry of pests and pathogens.
- The Andes are an important, economic and natural source of water for gravitational irrigation.
- (38) Relatively low production costs, especially in a work force required for successful hybrid seed production. This advantage was especially important in the initial growth of Chilean seed industry. However, the present work force has become increasingly expensive compared to other countries such as China.
- Good technological level provided by qualified producers and professionals and an adequate infrastructure for the production and export of seed. These advantages have been favored by the presence of multinational companies in the country.
- *ad hoc* legislation supports the needs of the seed industry. For example, Chile is an UPOV member which provides breeders with confidence that their rights will be protected. The Agriculture and Livestock Services (SAG), an institution sanctioned by the Chilean Ministry of Agriculture, is responsible for applying the legal and regulatory laws concerning seeds as well as controlling enforcement and punishing violators.
- The different seed production companies are organized in a National Association of Seed Producers (ANPROS) which encourages the strengthening and support of the seed industry.

(39) This table identifies the main consumers of Chilean seeds during 2005. The United States was the main importer with over 50% of the total value for Chilean seeds. France and the Netherlands followed in importance with around 10% of the total value.

(40) This figure shows the main seed crops exported during 2005. Maize is the most important species, representing 47% of the total export value. Vegetables as a group followed in importance with 34% of the export value. Flowers, canola, sunflower and forages were 6, 3, 3, and 2%, respectively.

(41) Maize traditionally has been the most important crop for seed export. In the last five years, it has accounted for 50% of the total seed export value. There are three types of maize seed produced in Chile. Commercial hybrid seed is the most important in volume and total value. The other two types are parental seed and seed for research. These represent a much lower export volume. However, they have a higher value per unit than commercial hybrid seed.

This table shows the evolution of maize seed and the main importing countries from 2003 to 2005. The USA has been traditionally the main importer of maize seed exported from Chile, accounting for approximately 80% of the total export value. Chile has taken advantage of the introduction of transgenic traits to hybrid seeds. Once seed companies have developed a new transgenic cultivar, they require quick multiplication of the seed for commercialization and recovering the research investment. In addition, producing seeds in a counter-hemisphere accelerates the release of new varieties. In both cases, Chile offers the seed production service to US companies and this is one of the causes of the high export value to the USA.

However, US participation decreased during 2004. This may be explained by two reasons. First, is the increased demand for maize seed by European countries in 2004, especially France and Germany, which was due to local climatic problems and lower seed production they experienced during 2003. Second, the USA had excellent seed production during 2003, allowing US companies to increase their seed stocks and consequently decreasing demand for seed in 2004. This is an example of how Chile takes advantage of its counter-season with countries in the northern hemisphere by supplying seeds that allow these countries to achieve their domestic needs. It is important to emphasize that, despite variations in demand for seed by years among importing countries, Chile's maize seed exports are considered to be relatively stable and predictable.

(42) During 2004, 20 companies produced maize seed in Chile. Of these, Pioneer was the most important, providing 32% of the total export value.

(43) Between 2002 and 2005, the export value of vegetable seeds fluctuated between 34 and 59 million dollars, respectively. These values represent 30% of the total value of seed exported by Chile.

During 2004, the main importer of Chilean vegetable seeds was the USA with almost 50% of the total export value followed by the Netherlands, France and Japan. In the case of vegetable seeds, significant export value came from such South American countries as Ecuador, Venezuela and Colombia, each with 2% of the export value.

(44) This table shows vegetable seed export values by crop between 2003 and 2005. During this period, pepper was the more important crop, accounting for 25% of overall vegetable seed exports during 2004 and 2005. The main destination for pepper seed during 2004 was the USA with 56% of the export value followed by the Netherlands, France and Spain with 27, 7 and 4% of the export value, respectively. Cucumber and tomato follow pepper in importance within this group and accounted for an average of 10% for each crop during this period.

(45) This table shows the average value per kg for exported seed of each vegetable crop. There are major differences among crops, which are explained by the type of seed and production technique. For example, the higher value of vegetable seeds produced by manual hybridization, such as tomato, pepper, melon and watermelon, increase seed prices over 100 dollars per kg. In contrast, lower prices are found for open-pollinated seed. Lettuce is an example of open-pollinated seed with values below 10 dollars per

kilogram. In the case of cauliflower, broccoli and onion where hybridization is accomplished by insects, the price is lower than hybrids requiring manual pollination, but higher than open-pollinated seed. In the case of cucumber and pumpkin, a fraction of the production is open-pollinated and the other is hybrid seed with prices varying from 10 dollars per kg for open-pollinated seed to over 100 dollars per kg for hybrid seed.

(46) During 2004, 29 companies exported vegetable seeds in Chile. The most important was Seminis accounting for almost 50% of the export value. Other important companies producing vegetable seeds in Chile are Pinto y Gajardo, Marambio, Sakata Seed Chile, ANASAC, Limagrin, Takii and Sunseeds.

(47) In spite of the significant growth experienced by the Chilean seed industry from the late 1990s, the growth rate of seed exports has recently decreased and plateaued. Some of the causes for this has been a significant decrease in international demand, a poor exchange rate, increased production costs and the increasing presence of other producer countries. As a result, profits have decreased and some production locations transferred to countries with lower costs of production, particularly Asian countries. However, some of that production is returning to Chile because of the ability to consistently produce high quality seeds.

(48) To face present and future seed production challenges, the Chilean seed industry has had to maintain and increase its reputation as a quality seed export country. To achieve this objective, specific areas have been targeted and specific actions taken. These include to:

- keep and improve the quality of seeds produced,
- increase the efficiency of production, i.e., to produce more seeds at lower cost in order to successfully compete with those countries with lower production costs,
- encourage a concerted and focused action of national seed producers, organized in ANPROS, and thus increasing investments in new technologies and identifying new markets, and
- encourage a higher interaction of different agents of the industry (companies, government entities and institutions dedicated to seed research and development) in order to solve technical and legal challenges related to the improvement of the Chilean seed industry.

In conclusion, Chile offers seed companies exceptional conditions for high quality seed production that take advantage of natural and technical conditions. As a result, the Chilean seed industry has experienced great growth in the last decades and today is the eighth largest seed exporter in the world. However, new development and challenges confront the Chilean seed industry and changes must occur in order for the country to continue this growth and to strengthen its reputation as a high quality seed producer.