GENOMICS APPLIED TO CLIMATE CHANGE RESEARCH CENTER

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Stresses exacerbated by global climate change have negatively affected agricultural production. In this decade, severe droughts and heat waves in the Midwest, Northeast and in the region of MATOPIBA (Maranhão, Tocantins, Piauí and Bahia), the country's newest agricultural frontier, caused losses of hundreds of millions of tons of Brazilian agricultural products (GUTIERREZ et al., 2014). The application of best agricultural practices and the development of varieties that are more adapted and tolerant to this new climate reality are necessary strategies to meet the growing demand for agricultural products.

Despite the indisputable importance of the role of research and development in the evolution of world agricultural production in food security, a decline in public funding for R&D has been observed worldwide (ALSTON et al., 2009). This decline is accompanied by an increase in private investments, mainly by companies in the seed sector, which, after a series of acquisitions and mergers, resulted in a greater concentration of participation in the world market and in technological domain (ETC GROUP, 2015; BRENNAN, 2016). With high investments and capacity for innovation, these large companies are able to continuously develop, through R&D pipelines that integrate genetic improvement and biotechnology, new cultivars with characteristics such as resistance to herbicides and pests and, more recently, tolerance to drought (PRADO et al., 2014; McELROY, 2004). Because they develop almost exclusively new technologies in the country of origin, where their research and development centers are located, the maximum performance of these technologies is not achieved in global consumer markets, where new discoveries are incorporated or adapted into local R&D programs.

It is strategic for the Brazilian agricultural sector, responsible for a quarter of the Gross Domestic Product, that national public and private institutions strengthen their scientific and technological production to contribute to the national development of technology and varieties appropriate to our demands. Facing the challenges of genetically adapting crops to stresses intensified by climate change requires long-term financing, interdisciplinary approaches and partnerships, often between public and private companies, which are closer to agricultural producers. At the end of 2017, a partnership between Embrapa, Unicamp and Fapesp created the Research Center in Genomics Applied to Climate Change (GCCRC), uniting the competences of the two institutions in agricultural biotechnology. The center's mission is to develop, over the next 10 years, biotechnological assets that increase the tolerance of plants to drought and heat and transfer the technologies developed to the productive sector.

Figure 1 illustrates the steps in the research pipeline employed by the GCCRC: 1. Discovery: new genes and microorganisms are identified and suggested to be introduced into the pipeline; 2. Proof of concept: gene constructions and microbial inoculants are prepared, transgenic and edited plants are generated and the first tests, under controlled environmental conditions, such as growth chambers and greenhouses and to a lesser scale on the field, are carried out for initial observation of the effectiveness of strategies; 3. Large-scale breeding and testing: genes and inoculums discovered and selected in the previous steps are tested in larger-scale field experiments, in various locations and years. Promising transgenic genes and events are introduced in elite strains of corn; 4. Pre-launch: commercial cultivars containing GCCRC technologies are developed; and 5. Launch: the technologies developed by the center are launched to the agricultural market.

RESULTS

The GCCRC built a modern infrastructure to meet the demands of the pipeline, with new greenhouses and laboratories for plant transformation, bioinformatics, and phenotyping. The center's first scientific and technological results are already being achieved. Unexplored and unknown genes associated with responses to abiotic stresses have been discovered and the first are in the proof of concept phase for corn and being testes in the field for sugarcane. The team has already mastered the gene editing technology in corn and edited plants are being generated continuously. Synthetic microbial communities composed of beneficial microorganisms that increase corn yield in stressful conditions have been discovered and tested under controlled conditions and in the field.

NEXT STEPS AND RECOMMENDATIONS

The GCCRC uses the corn crop as a research target, but the technologies developed could potentially be transferred to other agricultural crops.

Recent efforts in the sequencing and assembly of the genome and microbiome of plants in the rupestrian fields open a new path to be explored in search of new genes and microorganisms adapted to hydric and nutritionally limiting environments. Following the pipeline rationale, new genes and microorganisms are continually being discovered and tested by the center.

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Continued in Annex

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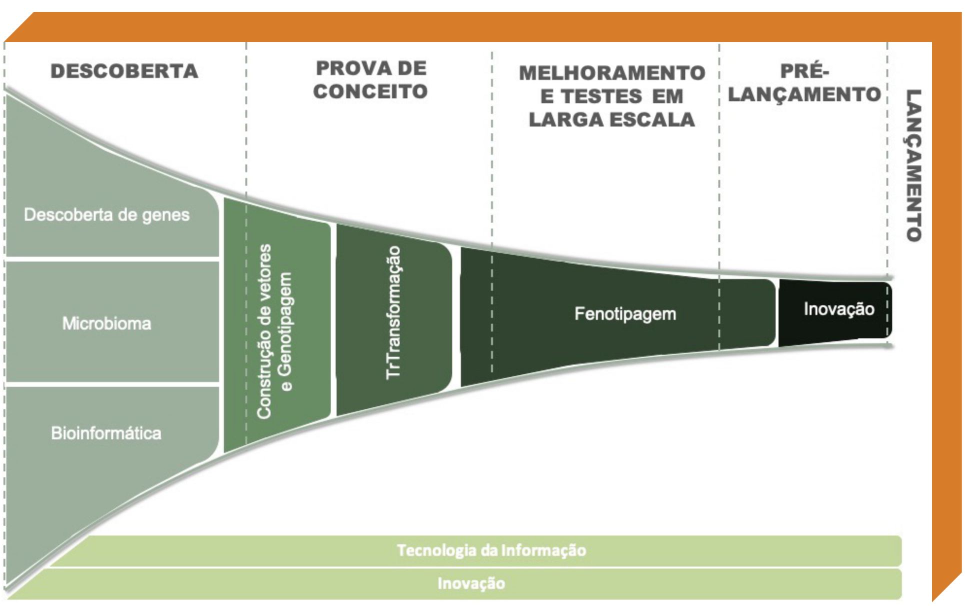
Figure 1: GCCRC R&D Pipeline



Source: Authors.