Environmental big data

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Abstract

Agriculture, fisheries, aquaculture, and forestry face the challenge of ensuring the food security of an additional 3 billion people by 2050 and food production will need to increase by 60% for food security to be ensured. Scientific efforts have to focus on tackling climate change in order to achieve a sustainable future for the food security of the world's growing population. The contribution of actions and decisions of genetic resources is required in order to face the effects of climate change on food and agriculture, as well as the effects of climate change on food and agriculture in the future. There is a broad storehouse of genetic information that can be used, throughout an essential number of techniques of bioinformatics, such as Next Generation Sequencing, Big Data management, data mining, homology modelling, high performance analysis of sequence, etc., and by putting them to work may have tremendous consequences for human health and nutrition and survival of the ecosystems as a whole.

Introduction

In 2017, more than 150 million people from over 50 countries were in a critical level of food insecurity or worse. The two main reasons causing these uncertainties are conflicts in their regions or extreme climate conditions, such as prolonged droughts, heat shocks, due to climate change. These climate and weather effects have affected every part of the world, causing huge economic losses of many billions of USD every year, especially in the agricultural sector. Climate change has altered every part of agriculture, under the prism of climate. While this continuing phenomenon, tends to be a normality, there seems to be a lack of research on the basis of survival, health and nutrition, from the aspect of genetics. With the continuing change of climate, the appearance of extreme climate phenomena and the constantly increasing population, there is an urgent need for scientific efforts to focus on a more sustainable future. Genomics, in combination with bioinformatics are a promising ally in the struggle to maintain food security and create a more sustainable future, through a wide range of methodologies and opportunities of managing biological data (Yung et al., 2021).

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Nowadays, modern science's needs have dramatically changed. The revolution following Next Generation Sequencing and advances in the field of bioinformatics and biotechnology, has caused an unprecedented data explosion which turned life sciences into a 'Big Data Business'. Lack of storage space has come into the spotlight, creating an urgent need for computational ability and storage capacity development. Time spent in solving space availability problems exceeds the actual time dedicated for collecting and analyzing data. During this time, huge amounts of data produced every day are being lost. Also, storage funding issue has reached prohibitive levels, more than sequencing itself. Technology and science have to keep up on the same pace in order to solve the data crisis that affects many life sciences fields, thus, having a huge impact on human health, environment and food industry. In order to be able to face all the changes happening to our planet and move research forward, scientists need to think outside of the box and alternative ways of handling the data volume has to be found (Thessen et al., 2020).

While native ecosystems are being challenged as never before, fortunately, plant genomes are a vast storehouse of genetic variability that can be used to help prevent the loss of species suffering from climate change. On the other hand, the use of genetics, offers new solutions that hold great promise to quantify the ecological and revolutionary responses of species exposed to changing climate conditions.

Big Data explosion in environmental data

A big data explosion has occurred causing major issues in data handling and storage and a massive losing of data every second (Figure 1). On the other hand, research and knowledge about the most important and ancient species on our planet is far away from extent. Extreme weather events and climate change threatens the survival of millions of people in many countries, especially in Africa and Asia. At the same time, food sustainability is at risk in developed countries due to the same problem. Damage and loss of agricultural sector have increased almost by 25% in the past 10 years due to the climate change. Agriculture is at stake, by the extreme climate conditions and climate change and this translates in making a huge number of people in urgent need of food and billions of USD being lost every.

The answer to these problems may rest into the scientific field of genetics, genomics, and bioinformatics. Development of biomarkers to improve molecular breeding and reveal relationships among species, discovery of new genes and a variety of genetic and genomic applications may result to revolutionary responses to the environmental danger. There is a broad storehouse of genetic information that can be used, throughout an essential number of techniques of bioinformatics, such as Next Generation Sequencing, Big Data management, data mining, homology modelling, high performance analysis of sequence, etc, and by putting them to work may have tremendous consequences for human health and nutrition and survival of the ecosystems as a whole (Varshney et al., 2018).

Agriculture, fisheries, aquaculture, and forestry face the challenge of ensuring the food security of an additional 3 billion people by 2050 and food production will need to increase by 60% for food security to be ensured (FAO, 2015). Scientific efforts have to focus on

tackling climate change in order to achieve a sustainable future for the food security of the world's growing population. The contribution of actions and decisions of genetic resources is required in order to face the effects of climate change on food and agriculture, as well as the effects of climate change on food and agriculture in the future. While the effects of climate change on species or certain population have been studied to some extent, very little information is known about the genetic response of species to climate change (2004). Climate change will influence all aspects of biology over the coming decades. Ecologists and scientists have to develop coordinating experiments in multiple aspects of climate change, across networks of field sites, both natural and man-made (Parmesan & Hanley, 2015). A breeding strategy based on genomics, especially for new cultivars, needs to begin by identifying the stresses that are going to be affected more under climate change (Abberton et al., 2016). Technological advances as genomic assisted breeding will play a significant role in the development of resilient crops to climate change (Kole et al., 2015).

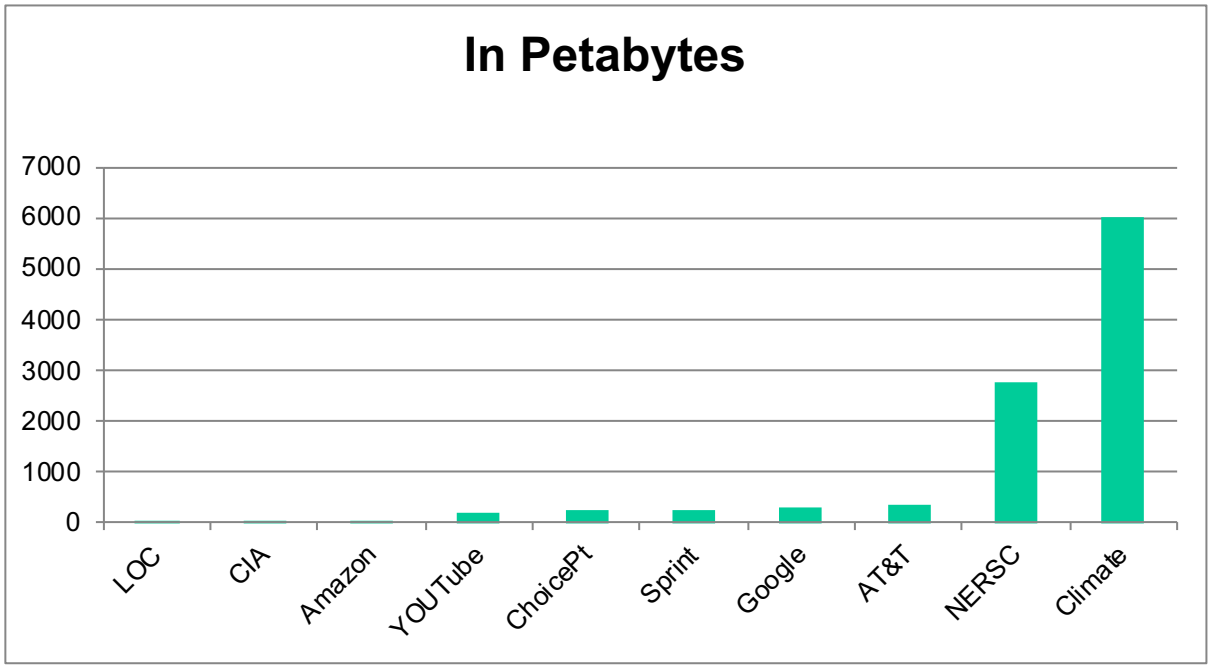

Figure 1. Top 10 largest databases in year 2017
Ref: http://www.focus.com/fyi/operations/10-largest-databases-in-the-world/

Conclusion

Earth genomics combined with bioinformatics have the potential to help maintain food security in the face of climate change. With advances in genomic sequences availability and easy access to such data, researchers will be able to discover and develop genetic biomarkers to improve knowledge of molecular breeding and reveal evolutionary relationships between the sequenced species via comparative genomic analysis in general. The continuing advance of sequencing technology will benefit all major crops in

the aspect of genomics in the next years (Abberton et al., 2016). While native ecosystems are being challenged as never before, fortunately, plant genomes are a vast storehouse of genetic variability that can be used to help prevent the loss of species suffering from climate change. On the other hand, the use of genetics, offers new solutions that hold great promise to quantify the ecological and revolutionary responses of species exposed to changing climate conditions.

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