SEED news

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Since 1997

The natural scarcity state of things

Reflections on the global scenario and challenges to agribusiness

summary

expedient

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editorial

Agribusiness increasingly challenged

The estimate that in 2050 there will be 9 billion inhabitants on Earth is a constant reminder of the global need for food, and how agribusiness has an essential part in enabling the achievement of the necessary result. Increasing production considerably involves making the best use of finite resources.

In the central article of the July issue of SEEDNews Magazine, the reality of a state of scarcity in resources, be they natural, human and capital, is addressed. Drawing a parallel between the three, building the history of the transformation in Brazilian agricultural production over the years and demonstrating evolutions and paths to follow. The text highlights the conclusion that the country still has great growth potential and will be put to the test in its central role in the world's demand for food.

The harmony of the productive chain that involves human, capital and natural resources is what makes the difference between a satisfactory result or not. Always guided by new technologies, which are generally the driving force for changes in levels, humanity can have its future demands met, even with the maximum scarcity of things.

Also, in this edition, the work developed by Syngenta in seed production in Brazil is an issue, pointing out its great relevance at the national level and the quality of the varieties of soy and corn, in addition to the efforts in seed treatment in the industry (TSI).

The July magazine also has another series of myths and truths, this time about the production and technology of seeds, an article about the global scenario in the commercialization of new biotechnologies, in addition to production regarding the gene flow in rice.

Another article in this edition deals with innovations in seed quality assessments, indicating a natural path in the advent of new techniques with input from embedded electronics and artificial intelligence. Information about the Seed Analysis Bulletin (BAS), an important document in proving the quality of the lots, is also an issue.

Good reading!

CONSULTING

After working for decades in the seed area, on several companies, with emphasis on Coodetec, where he was executive director for more than 10 years, dr. Ivo Marcos Carraro created his consulting company I.M. Carraro with a focus on the seed business. Carraro was director of Abrasem for several terms, being also president of Braspov, of which he was one of the founders. Recently he was on the board of directors of the company Jotabasso. Contact: carraro692@gmail.com

NEW POSITION

Wagner Seara took office as commercial director of the company KWS. As a Professional with extensive experience in seeds, especially in the commercial area, Wagner will have the great function of promoting, disseminating and identifying marketing channels in the traditional german company. In Brazil, the company works with corn, soy and sorghum seeds. The competition is strong, however the effort rewards in which qualified personnel make the difference.

PARENTAL SEEDS

José M. Betemps Vaz, with a master's degree in seeds, stressed that he has been for several years as the leader in the production of "parental" maize and soybean seeds of the Syngenta company. This work, in addition to involving technical-scientific aspects, also involves commercial and management aspects, since new materials are placed on the market every year, and seeds must be produced in an adequate quantity of both new materials and those already on the market. Fortunately, the country has institutions that prepare us well for the challenges.

BIOTECHNOLOGY
Dr. Liliane henning, a researcher at “Embrapa”, has just taken over as one of the 27 members of the national technical committee on biosafety (CTNBIO), a government agency that analyzes the scientific aspects of genetically modified organisms (gmos), as well as new breeding techniques for marketing purposes. CTNBIO is internationally recognized for its scientific analysis, in which since its creation, has already approved more than 160 events. Liliane has a solid background and experience and will greatly contribute to advances in technological innovations for the sustainability of agriculture.

QUALITY CONTROL
“Iberá Sementes” from Ponta Grossa - PR, has just hired Elisa Lemes and Verônica Betat to conduct the quality control process in soy and wheat companies. The quality of the seeds is being a factor of competitiveness of the companies, requiring qualified professionals for the production and evaluation. The investment tends to bring good dividends.

INTERNATIONAL TRADE
Last june, the international seed federation (ISF) held a virtual event to analyze technological innovations and the future of the seed industry after Covid-19. The event was attended by ISF, FAO directors, several executives from seed companies and associations of farmers. There is a consensus that the domestic seed market will be little affected, however exports and imports will be more affected. In this sense, in order to minimize the negative effects, national seed associations have an essential function of making the authorities aware of the importance of seeds, according to ISF general secretary Michael Keller.

TECHNOLOGY
In general, there are several uses for a crop. Césas Castellanos, with a doctorate in seeds from UFPEL, informs that he is working with medicinal cannabis, in order to maximize the production of seeds that produce female plants, from which medicines are extracted. “Your knowledge of seed physiology and technology will certainly be useful in identifying processes or products that maximize the production of female cannabis plants”.

EXPERIENCE

João Carlos Nunes, one of those responsible for introducing and disseminating seed treatment in industry (TSI) in the country, is using his knowledge and experience in a laboratory to assess the processes involved in "TSI", in a partnership with the company Momesso. João Carlos, also remains active as a consultant for product development, mainly identifying dosage, effectiveness and phytotoxicity.

PROGRESEED

Consultoria
Sementes para Pastagens

FORAGES

Francisco Dubbern de Souza, recently retired from Embrapa, decided to open a micro-consulting company in the field of forage seeds, especially those of tropical climate. Francisco is a SEEDnews collaborator with several published works that greatly helped the country's forage seed sector. The company is called PROGRESEED, and can be contacted by fdsouza@gmail.com

NICHES MARKET

There are several types of corn for different uses, as can be seen in our daily lives. In this sense, Olivier Crabos, with his extensive commercial experience with several seed companies, including some international ones, is in the process of identifying materials to be used for "Cangica". He obtained from germplasm banks several white maize materials with potential for use. He estimates that by 2022 he already has material to sell.

INVESTMENT

The soybean production process has changed a lot in recent years. In this sense, Airton Francisco de Jesus, from the company Jotabasso, points out that it is normal to have only 15-20 days to carry out the harvest, a key stage of success. This required a strong investment in harvesting, logistics and post-harvest processes, which fortunately in 2020, had its return. To achieve quality with quantity, investment in technology is essential.

TRAINING

The doctor. Geri Eduardo Meneghello, from UFPEL, a disputed professional for lectures and courses on seeds, following the isolation recommendations, adapted his participation with the seed companies, using the digital tools available from his home. Stresses that this training alternative is here to stay, however, there are cases in which physical presence is still the best option, such as practical classes and the interaction of participants in some cases.

EVENTS

ENSSOJA
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XXI CBSEMENTES
29/03 to 01/04/2021
Curitiba - PR - Brazil

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This space is destined for subjects that are under discussion on the seed environment
Use our hashtag #focusonseeds and collaborate with this page through social media

United States eases rules for approval of new biotechnologies

A major shift in regulation in biotechnology will exempt some gene-edited plants from US government supervision. The new policy published in May also requires automatic approval of variations of established types of GMOs, facilitating their way to the market.

"The main positive aspect is that it will allow certain aspects of gene editing to move forward," says Kent Bradford, a plant geneticist at the University of California, Davis. If researchers use gene editing to design a plant that could have been created conventionally, the new plant will be exempt from regulation. But anything else - like moving a gene between species or turning metabolism back on - will still require a regulatory review.

The essence of the change is that the US Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) will now focus on new features instead of the technology used to create them, a change in approach that scientists plants have been searching for a long time.

Modernizing legislation on seeds and seedlings

In a recent online debate on the "Academiadasemente" Instagram page, Dr. Virginia Carpi stressed the importance of the law on seeds and seedlings (10.711) implemented in 2003 (regulated by decree 5.153 of 2004), as it was vital to consolidate the national system yet under development, giving identity and quality assurance to all propagation material produced and marketed in Brazil.

Today, after 16 years, there is a very different scenario, with solid and robust legislation fully implemented and respected. For this reason, there is a consensus that the system is capable of a differentiated level of standardization, making it possible to bring modernization tools, self-control and even self-regulation to the seed chain. With this, we would not need a decree in such detail, simplifying the whole process with a clearer and more concise language.

There is a wide range of possibilities for the normative instructions to be edited taking into account all the technological evolution that has existed since the beginning of the century, significantly reducing the process from initial registrations to the commercialization of finished products.

Biodiversity and sustainability in focus in Europe

Recently, the European Commission, executive part of the European Union (EU), announced the adoption of a new plan in search of achieving greater biodiversity and paths to a more sustainable food system. Called "EU Biodiversity Strategy for 2030", it is divided into two main strategies called "New Biodiversity Strategy" and "Farm to Fork Strategy", the initiative is in line with the plans of the "European Green Deal".

Among the main actions involved in deadline strategies until 2030 are the transformation of 30% of Europe's land and seas into protected areas; planting 3 billion trees; 50% decrease in the use of pesticides and loss of nutrients; reduction in the use of fertilizers by 20%; and that 25% of the land destined for agriculture is characterized by organic models.

EuropaBio, the body representing several biotechnology companies in Europe, released a note reiterating the need for innovations and new technologies directly linked to biotechnology so that the goals set do not make European agriculture less productive

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Myths and truths

SEED PRODUCTION AND TECHNOLOGY

In the edition of SEEDnews XXIV # 3 of 2020, some aspects of seed quality were considered as myths and truths based on works published by ABRATES and developed by research institutions. In this edition, myths and truths in seed production and technology are being published.

Seed treatment in the industry is better than on farm

In general, the application of any product in liquid form in a batch containing millions of seeds involves two stages, which are: homogeneous application and distribution.

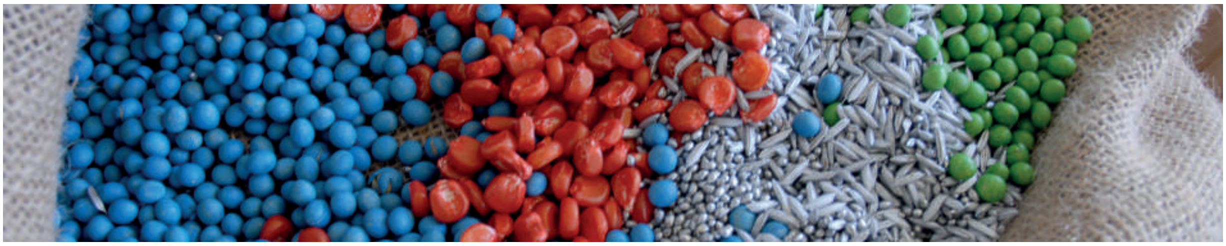
The initial application of a product can occur under the continuous flow of the seeds or, in a batch with specific quantity and volume inside a "drum". Nowadays, most of the equipment used for treatment in the field is of continuous flow, and its technology has evolved a lot in recent years, leaving behind the use of the old and rudimentary "concrete mixers" for batch treatments.

After the initial application, it is crucial to have a homogeneous distribution of the liquid so that all the seeds of the batch are equally involved in the product. If the dispersion of the product is not wide at the beginning of the process, it will not be possible to achieve a good later distribution, resulting in many seeds with overdose, as well as others with a low amount of active ingredient.

There is a very wide variation in the levels of technologies available for seed treatment to the farmer in the field, which, together with the necessary high training of their employees involved in the process, can lead to inefficiency, waste and subsequent problems in the establishment of crops.

In an analysis of the active principles of fungicides and insecticides present in seeds treated "on farm" in the state of MT (harvest 2018/19), 68% of the samples showed a range of 75 to 280%. On the other hand, the analysis of the active ingredients in the samples from the "TSI" varied by a maximum of 20%, while 95% of the samples were with a maximum variation of 13%.

It is worth remembering that, for example, in soybeans, each plant absent per meter in the sowing line has a negative impact of approximately 240 kg per hectare.

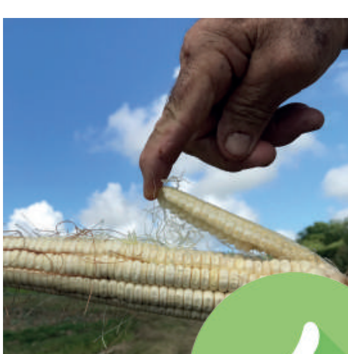


The cultivation of low technology seeds does not contribute to sustainability and diversity

For many years, diversity has been used as an argument to favor the use of low technology seeds, mainly in small farms and, involving seeds from conventional corn cultivars instead of hybrids.

Undoubtedly, diversity is vital, both for the sustainability of agriculture and for the continuous evolution of plant breeding programs.

However, insisting on planting low-yielding varieties solely for environmental merit causes significant losses to farmers and society in general. This is because the defenders of this thesis forget that there are many germplasm banks established around the world for the sole purpose of maintaining extensive collections of germplasm of the most varied species of seeds, orthodox or even recalcitrant. The most famous germplasm bank today is from Svalbard (Global Seed Vault), in Norway, which has the capacity to store up to 4.5 million samples.



In dry climate regions during harvest, there is no need to invest in drying facilities

There are many regions in Brazil and the world whose harvest season provides a dry climate, mainly without rain or high relative humidity, which limits the respiration of the seeds and significantly favors their physiological quality, such as the Brazilian "cerrado" area.

As a result, many professionals believe that there is no need for investment in seed drying structures within their production units.

Obviously, this scenario is actually more favorable for the production of seeds than humid and rainy regions during the harvest, being fully possible to obtain lots with quality above the minimum standards required for commercialization.

However, there are two factors that will always punish those producers without drying capacity.

Although the samples and reports establish an average humidity value observed in the seed field, we must always remember that each hectare has a population containing millions of seeds. Among these, it is normal to expect large variations in maturation and thus moisture. With this, even with low average water content in the batch in general, there will always be moist seeds among the others, bringing risks of deterioration and proliferation of pests and diseases during storage, as they are not always removed in the process of successful processing.

When waiting for the uniformity of seed moisture in the field so that the harvest can be made without the need for drying, the producer will always (inadvertently) cause the deterioration of the drier seeds, that is, those that remain in the field for longer.

Academic tests have already shown that even without rain, there is a variation of up to 5% of the water content of the seeds between morning and afternoon within a period of 24 hours. This leads to high respiration rates and, therefore, constant energy expenditure of the seed, whose energy reserve will no longer be available for its vigorous germination in the next harvest.

The sooner the seed is harvested after physiological maturation, the higher it will be for its quality, due to the lower respiration rates in the face of bad weather in the field. Today, 100% of the companies producing hybrid corn seed (for example) harvest the cob to meet this precept. With this, drying will always be synonymous with quality within companies.

Drying at night takes longer than during the day

It is common to hear dryer operators claiming that drying efficiency decreases during the night, mainly due to the drop in temperature and elevation of environmental humidity, which affects the conditions of the drying air, decreasing its efficiency.

However, despite the fact that during the night the air temperature is lower and the relative humidity higher, these physical properties of the air are corrected by artificial heating of the air, maintaining the same relative humidity of the day. What happens is more energy consumption (ex firewood) at night to heat the air.

In general, in intermittent or continuous dryers, the air temperature during the day is heated from 30 to 60oC, while at night the air is heated from 20 to 60oC. In this way, using the same temperature, relative humidity and air flow, the drying speed during the day or at night is the same.

Also, the routine of periodic follow-up of the dryer must be specially monitored, as in many cases, it is noticed that there are greater occurrences of neglect during the night, showing problems related to the environment and equipment.

It is feasible to store soybean seeds in a bag silo

Many professionals who encourage the use of bag silo for seed storage claim that the longevity and quality of the product is guaranteed due to the elimination of O2 within the environment of the bag silo after a few days of use. Thus, the respiration of the seeds would cease and, therefore, there would be no subsequent energy expenditure and accumulation of water and CO2 next to the seeds, without causing a drop in quality.

The elimination of O2 inside the bag silo occurs only after too long a period of exposure to conditions unsuitable for storage in the field and in the silo itself, and thus suffers high deterioration related to the long period of exposure to improper conditions of temperature and humidity inside the silo. , mainly due to the accumulation of water and CO2 generated from the respiration of microorganisms, fungi, bacteria and other pests present.

Soybean seeds should preferably be harvested with a humidity of 16 to 18% in order to guarantee their highest quality, being important for this purpose, to reduce the moisture of the seed through drying to 12 to 13%, proceeding to storage in favorable conditions and if possible controlled environment.

The investment in storage system, whether in silos or warehouses is considerable, however, it proves to be important in the production of high-quality seeds.

Even small farmers should grow hybrid maize

In a quick analysis, we know that the cost of hybrid maize seeds reaches around R $ 800.00 / bag of 60,000 seeds (13-20kg), while Creole seeds cost little more than the price of the grain, which can ranged from R $ 20.00 to R $ 50.00 per 60kg bag in the last decade.

In addition, it is true that seeds with high added value, such as hybrids themselves, require greater investments in crops in several aspects during the crop cycle so that plants can perform to their maximum potential without limitations such as fertility, diseases, pests and / or even lack of water.

However, if there are sufficient resources available to the plants, it is possible to estimate yields 5 times higher than creole seed lines of corn, often cultivated generation after generation by small farmers, for example.

Thus, it is estimated that in a hectare of hybrid corn, the investment will be around R $ 2,500.00, while its return will be approximately R $ 8,000.00 offering a net profit of R $ 5,500.00. In the case of Creole varieties of hybrid corn, the investment will be around R $ 1,000.00, while its return will be approximately R $ 1,500.00 offering a net profit of only R $ 500.00 per hectare.

Therefore, it becomes evident that the cultivation and investment in hybrids with higher technology offers much higher returns to the farmer, whatever the size of his property, as long as he can control the factors of production.

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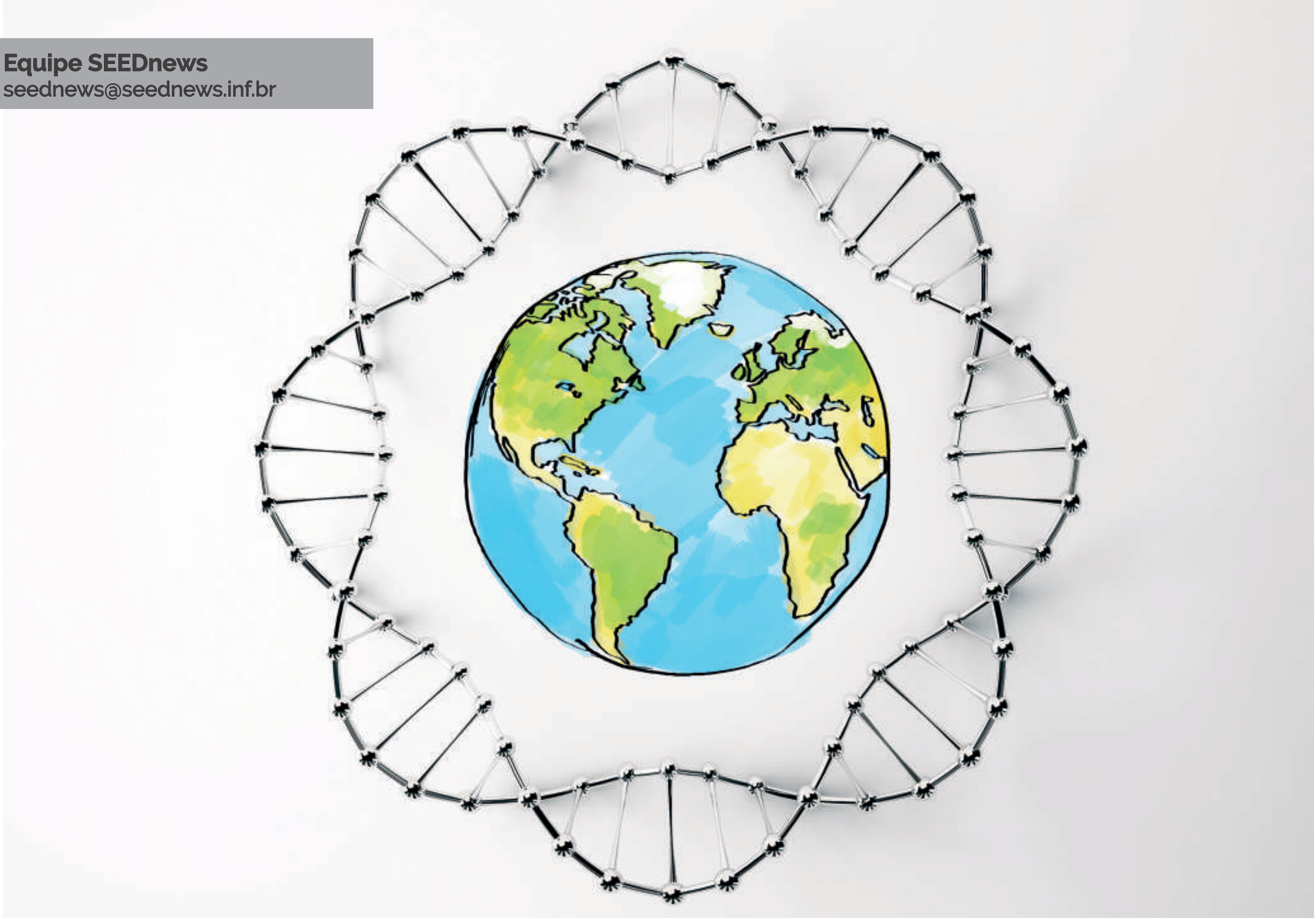

The global scenario of new biotechnologies

The protection

In terms of rights, there are two mechanisms of intellectual protection used in Brazil: the patent system (Brasil, 1996) and the “sui generis” rights of cultivars (Brasil, 1997). Once protected and released to the market, the technologies (processes and plants) guarantee the due profits for their owners through the payment of technological fees (patent) and royalties (cultivars).

Regarding the first mechanism, the Industrial Property Law (N ° 9279, of May 14, 1996) specifies that “all or part of natural living beings and biological materials, even when their genome or germplasm are isolated, as well as the biological natural processes ones’’ are not considered inventions. Thus, it is important to note that GM plants and animals are considered inventions in Brazil, but are not patentable according to Article 18 (III, according to Law No. 9279/96).

The only living beings that can be considered patentable inventions under Brazilian law are transgenic microorganisms (involves a process to be introduced into plants), which can be patented if they meet the two conditions of patentability (clarity and descriptive sufficiency) and the three requirements patentability (novelty, inventive step and industrial application). In addition, processes involving living organisms (for example, methods for the development of transgenic plants), gene constructions (for example, expression vectors), recombinant proteins and biological extract compositions are also patentable under Brazilian law. Patent protection

MAIN GMO TECHNOLOGIES APPROVED IN SOYBEAN IN BRAZIL

Source: CTNBio e ISAAA

Breeder***	Event type	Commercial traits	Protein	Pending approval**	CTNBio approval	Commercial launch in Brazil*
Monsanto	RR	Herbicide tolerance	CP4-EPSPS	-	1998	2005/06
Bayer Cropscience	Liberty Link	Herbicide tolerance	PAT	-	2010	-
Monsanto	INTACTA RR2 PRO	Herbicide tolerance + Insect resistance	CP4-EPSPS Cry1Ac	-	2010	2013/14
	XTEND	Herbicide tolerance	EPSPS; DMO	-	2018	-
	INTACTA 2 XTEND	Herbicide tolerance + Insect resistance	Cry1A.105; Cry2Ab; Cry1Ac;dmo; cp4-epsps	European Union	2018	2021/22
Dow AgroSciences	Enlist E3	Herbicide tolerance	aad-12 v1 pat 2mepsps	-	2015	-
	Conkesta	Insect resistance	cry1Ac cry 1F	China and Europe	2016	-
	Conkesta Enlist	Herbicide tolerance + Insect resistance	aad-12 vi, 2mepsps; pat; cry1Ac; cry1F v3	China and Europe	2017	2021/22
TMG	HB4	Drought tolerance	HAHB4	China and Europe	2019	2021/22
	HB4 + RR	Tolerance to herbicide and drought	HaHB4; EPSPS	China and Europe	2019	2021/22
Basf/Embrapa	Cultivance	Herbicide tolerance	Csr-1-2	-	2009	-

*Estimated by the breeder **Approval regarding the import of a product for the purpose of animal or human nutrition (considering only Europe and China) ***Including companies acquired in the past and/or mergers (-)No information is for 20 years.

This means that, in the case of GM plants, the tools and methods for their development can be protected, but not the plants themselves. In this case, it is possible to resort to the second mechanism, known as cultivar protection, based on "sui generis" rights and regulated by Law No. 9456/97 (Brazil, 1997), which grants owners protection for 15 years.

Process

New cultivars containing technology obtained through transgenics, to be marketed in Brazil, it is essential that it is also evaluated and approved by the respective committees and authorities of foreign markets around the world.

Until then, this regulation could take up to 10 years, affecting the commercialization of many new features in biotechnology, which means less time for its breeders to enjoy the economic return via the technological rate of their patent, in addition to preventing farmers from accessing them.

This may have been the case with the "Cultivance" and "Liberty Link" technology in Brazil, for example, which were approved by CTNBio in 2009 and 2010, respectively, but released for sale only in 2015 and 2016 due to barriers in other soy import markets, such as China and the European Union. With this, the delay in the complete release in global trade resulted in the lower attractiveness and benefits of the technologies compared to other GMO products already commercialized at the time of their full approval, as the market reality had already been changed, with less impact and demand from technologies in agribusiness.

This impediment was a matter of debate and friction for many years, which resulted in a new agreement signed by the USA and China in the last years after the end of the extensive trade war in 2019. Within the new agreement, the Asian country promised to optimize the duration for approvals of new GMO events. With this, the proposal is that the approval process lasts no more than 2 years.

The agreement also benefits Brazilian producers, especially those of soybeans, since Brazil is the second largest grain exporter at the moment, with China being the world's largest importer.

However, the European Union still presents itself as one of the major challenges for the approval of new events arising from biotechnology.

Despite the amount of scientific information available and the opinion of experts worldwide, on July 25, 2018, the European Court of Justice (TEJ) determined that organisms obtained by gene editing techniques, such as CRISPR-Cas and any other genome editing method, are in principle subject to the same regulations as genetically modified organisms (GMOs).

That is, in addition to the usual delay in approving genetically modified organisms (GMOs) in Europe, the current regulations in force expose biotechnology products generated without the insertion of genes from other species to the same rigor of approval required from transgenics, significantly burdening and delaying the global launch of new biotechnologies.

It is always important to value the appropriate scientific discussions and analyzes necessary as a form of prudence and care in handling and approving so many novelties obtained through biotechnology, whose development becomes increasingly faster and more accessible thanks to the increasing evolution of tools, such as arising of gene editing.

Within the soybean culture, one of the most planted vegetables in Brazil and in the world, there are several technologies awaiting approval both in China and in Europe, which are estimated to start in 2021/22. Among these, one of the main novelties is the advent of drought tolerance, whose event (HAHB4) was submitted by the company "TMG" and has already been approved by CTNBio in Brazil in 2019.

Some records

When analyzing the history of controversies around the subject, we found that many losses were caused by excessive reactions to GMOs, for example.

In this case, one of the main examples in Brazil is evident in beans resistant to the golden mosaic, achieved through genetic engineering and released for sale by the National Technical Commission on Biosafety (CTNBio) in 2011. The bean brings the RMD technology, which helps the farmers in saving production costs, reducing the use of chemicals and, in productivity, without the occurrence of the disease, achieving a better profit margin and a cheaper product in the hands of consumers. However, due to the extensive battle of science in relation to the remaining inconsistencies of public opinion with transgenic products, such benefits suffered many delays until reaching the agricultural chain.

In 2016, more than 100 Nobel Prize winners (109) signed an acidic open letter against "Greenpeace" for their rejection of GM foods over the years.

The letter accuses Greenpeace and other NGOs with an anti-transgenic stance of "distorting the risks, benefits and impacts" of genetically modified organisms and "supporting the criminal destruction of experimental crops". According to scientific data, genetically modified foods are as safe as any other, and there has never been a single confirmed case of an adverse effect on the health of humans or animals.

The letter's authors also recall that the FAO (UN body for food and agriculture) estimates that the world production of food and feed will need to double by 2050 to meet the needs of the growing world population and that transgenics will be one of the main paths for ensure that we achieve this goal.

Pyramidation

The continuous progress in the pyramidization of different events for insect resistance and herbicide tolerance are also expected to be approved and commercially launched in the coming years.

The "Intacta 2 Xtend" technology, which currently belongs to Bayer, was recently approved in China in June 2020, but it still depends on the European Union's release for its commercialization to be released.

Having been approved by CTNBio in 2018, the platform offers a combination of events (stack) involving insect resistance (cry1A.105 + cry2Ab2 + cry1Ac) and tolerance to the herbicides Glyphosate and Dicamba.

Corteva, for its part, is also investing in the platform called "Enlist Conkesta", which brings a combination of tolerance to the herbicides Glufosinato, Glyphosate and 2,4D, in addition to insect resistant genes (cry1Ac; cry1F v3). In this case, it has also been approved by CTNBio and is awaiting approval from the main markets in the world, such as China and Europe.

Both technologies are expected to be commercially launched in the 2021/22 harvest and will be important in combating several glyphosate-resistant weeds, which have reports of alarming levels in several fields in Brazil, such as "buva", in addition to offering resistance to insects that increase the protection that current technology already provides against caterpillars, including the genus of spodoteras.

In addition to soybeans, several other crops should have easier entry of GMOs into the market.

According to ISAAA, it is estimated that a total area of 80.5 million ha was planted with varieties containing pyramid events (stacked) in 2018, which is the combination of two or more genes of interest in a single plant. This represents more than 42% of the 191.7 million ha of biotechnological crops planted worldwide.

One of the greatest examples is observed in the corn crop, which already has 35 events approved by CTNBio since 2007, 24 with pyramidation of events (usually combining herbicide tolerance and insect resistance). However, only 12 technologies have been fully approved around the world.

Cotton, on the other hand, already has 18 events approved by CTNBio since 2005, 14 of which have pyramid events and only 6 are fully approved in all foreign markets.

Comment

In addition to the long period required for the development and approval of many "disruptive" technologies on the market, it is also necessary to consider the high cost inherent in the research and regulation of each event by companies (public or private), which faces legislation highly demanding around the world.

With this, the development of high impact technologies has its efforts concentrated mainly on the main crops with the highest financial return, such as soybeans, corn and cotton.

More thoughtful legislation could expand the development and adoption of technologies for other crops and species such as vegetables, forages and even ornamentals.

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Gene flow in rice

Although there has been an evolution in the rice crop in recent years with the increase in productivity, it is known that the maximum yield potential is not yet reached by rice farmers. This fact is due, basically, to the unsatisfactory control of the weeds, among which red rice stands out as a limitation of the increase in productivity, due to the reduction in yield caused by competition with cultivated rice, the depreciation of the final product, control difficulties, extent and degree of infestation of cultivated areas.

Cultivated rice and red rice are classified as belonging to the same species, with red rice having a reddish-colored grain pericarp. The similarity between cultivated and harmful species, with regard to morphophysiological and biochemical characteristics, makes the competition exercised more severe and with greater control difficulties.

The existence of several red rice biotypes with very high morphological variability raises doubts as to whether they are descendants of the red rice biotypes that were cultivated in the past or whether they were altered through natural crosses that occurred with rice grown over a long period of time.

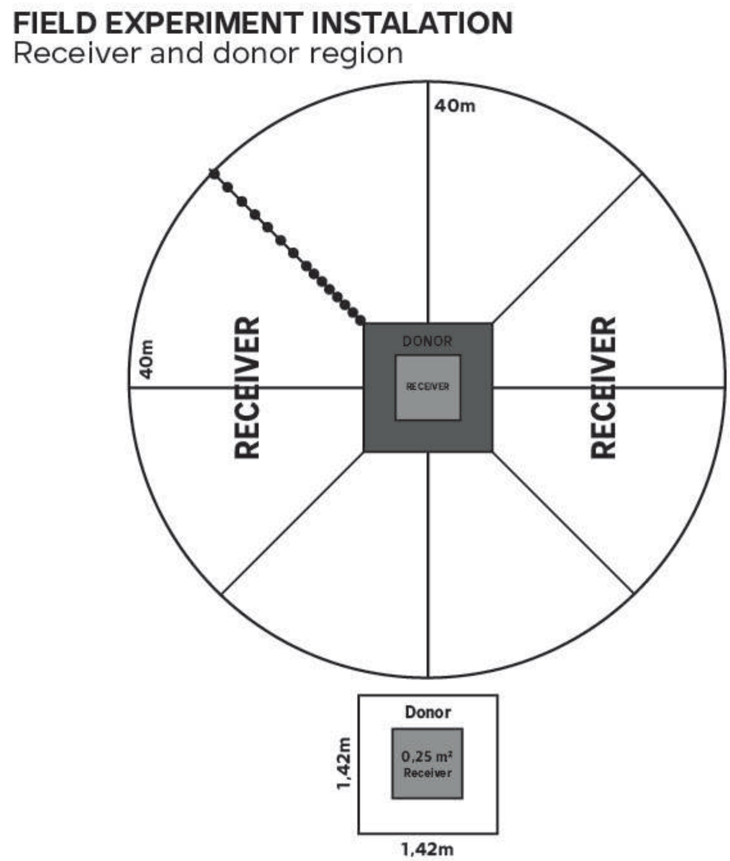
The search for solutions to this problem is a point constant focus on research, in which the development of herbicide-tolerant rice cultivars is presented as an alternative to minimize the presence of red rice in cultivated areas. As an inconvenience, there is the risk of cross-pollination between the tolerant plant and the red rice

In this sense, the development of the rice cultivar IRGA 422CL, tolerant to the herbicide "Only" of the chemical group of Imidazolinones, presented itself as an alternative to minimize the problem of this species.

Despite the evident benefits of rice varieties with herbicide tolerance, the concern that they may have some negative impact on the environment, such as the escape of the herbicide tolerance gene for red rice, has been the subject of studies.

For this tolerant cultivar to be effectively considered a technology and to be able to be integrated into the production systems, it is necessary that it does not represent risk in the environment, an essential condition for the commercialization to be carried out without restrictions. Simulations and inferences are necessary and must be carried out to show, quantify and determine the intensity of probable product restrictions by any of the components of the production system.

The development of herbicide-tolerant rice cultivars presents itself as a new alternative to minimize the presence of red rice in cultivated areas. The risk of cross-pollination between the tolerant plant and red rice has been suggested as the first potential problem with this production system.



Based on these assumptions, a study was designed to determine the magnitude of cross-pollination in rice as a function of the distance between donor and recipient.

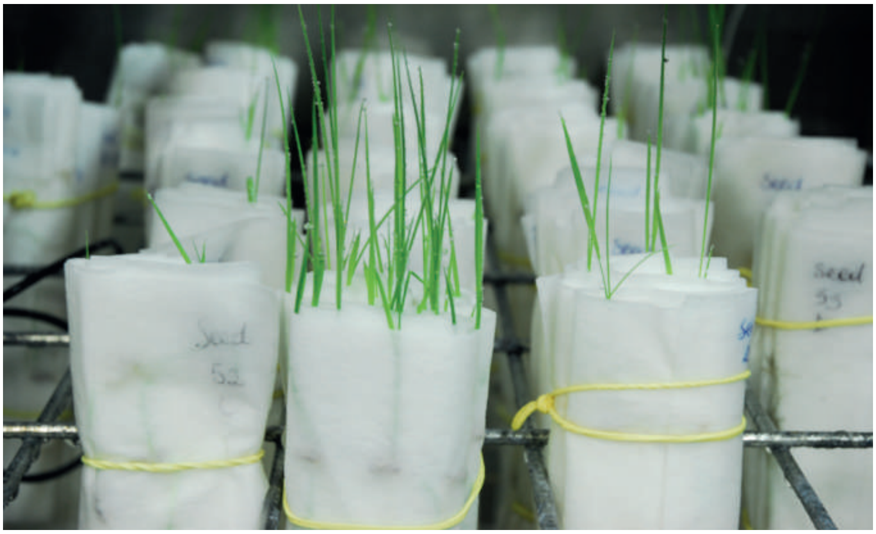
The study

Basically, the study consisted of using two rice cultivars with the same cycle and height, but differing in resistance to an herbicide and sown in such a way that the flow of pollen grains between cultivars was as large as possible.

Thus, the cultivar IRGA 422Cl was used as a pollen donor and tolerant to the "Only" herbicide of the chemical group of Imidazolinones, and as a pollen-receiving variety, the cultivar IRGA 417, the study being repeated for three years.

Fieldwork

The pollen receptor cultivar IRGA 417, was sown in an area of 6.400 m^2 (80m x 80m), while the tolerant genotype IRGA 422CL (gene - donor), was sown in the center of the block, in an area of 2m2. In this

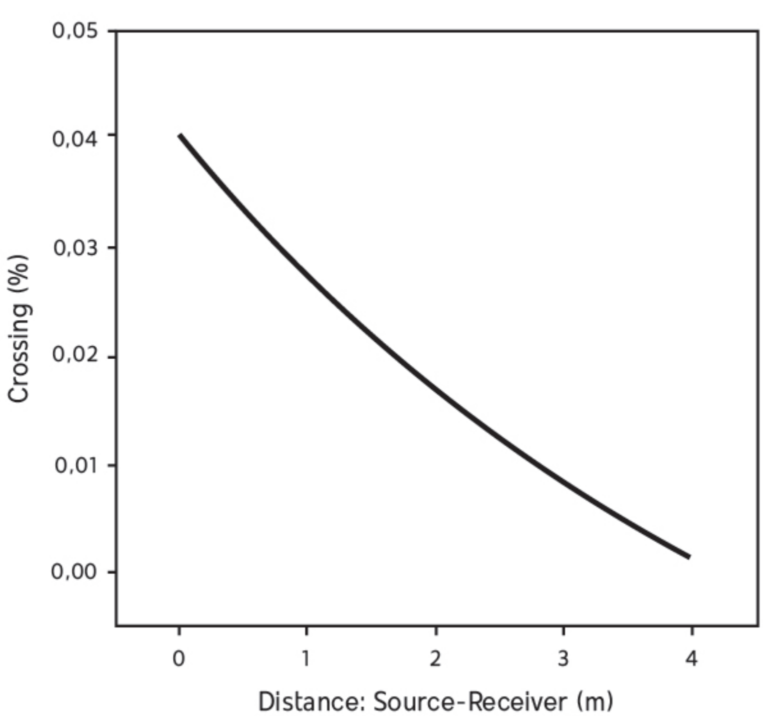


Evaluation of gene flow by the germination test

area, inside the frame, a free area of 0.25 m^2 (0.5m x 0.5m) was reserved where the receiving material was sown in order to provide maximum hybridization condition (Figure in the text).

Eight rays (quadrants: N, NE, NO, S, SE, SO, E, O) of 40 m in length were established, starting from the center to the edge, spaced at 45 °, on which the sampling areas were demarcated. of seeds. In the first 5 meters, these areas were demarcated every 1m, and then spaced 2.5m apart, establishing 19 sampling units per radius, and another sample in the center, totaling 153 samples. The sampling units were 1m^2, where 300 grams of grain were harvested.

CROSSING PERCENTAGE
as a function of the distance between the gene source and the receptor, averaging 8 quadrants and 3 years



Evaluation of cross-pollination

Only the seeds of cultivar IRGA 417 were evaluated, as the objective was to verify the gene flow of cultivar 422Cl resistant to the mentioned herbicide. Thus, as the resistance character is dominant, any seed of cultivar IRGA 417 that was hybridized with pollen of cultivar IRGA 422CL would be easy to detect in the germination test specially designed for this purpose.

The seeds were evaluated 4 months after harvest so that the possible dormancy did not affect the results. The evaluation consisted of placing the seeds to soak in 0.2% solution of the herbicide Imazethapyr, for six hours before incubating for the germination test, allowing the separation of seeds from susceptible rice cultivars. The tolerant seeds survived and produced normal plants, while the susceptible seeds did not germinate or became abnormal.

Of the total collected seeds, 309.000 seeds were analyzed (21.6% of the seeds harvested, except those in the center, which were 100%), 2.000 seeds per experimental unit (eight quadrants and different distances within each quadrant) containing approximately 9.260 seeds , equivalent to 300 grams, giving a total of 927.000 evaluated seeds.

Results

The results showed the occurrence of a low cross-pollination rate in irrigated rice, even in the most favorable condition of the factors that could interfere in the process. This rate showed an average of 0.042% at the place where the pollen-receiving plants (center) were surrounded by pollen-donor plants, that is, maximum pressure for the occurrence of cross-pollination, also considering that there was full floral coincidence between the plants.

There was a significant decrease in the pollination rate, as the distance between pollen donor and recipient plants increases, regardless of the year and wind direction, with average values of 0.025%; 0.017%; 0.011%; 0.0% up to 01m; 02m; 03m and 04m, respectively. These values show that each meter that distances itself from the pollen donor source, there is a reduction in crossing around 32 to 35%.

Considering the data obtained and related to the risk of gene flow from cultivated rice to red rice, in a plant community in which both are mixed, the distance to where hybridization occurs, as well as the quadrants in which it occurs most frequently, has little importance, since in all cases these plants will be surrounded by both the recipient and donor plants, at any point of the crop. However, this information can be of great value for the production of seeds for isolation between cultivars and in the production of hybrid seeds in particular, since the rows must be oriented in the transversal direction to the direction of the prevailing winds.

Using the herbicide resistance characteristic in the rice plant as a marker, it makes it possible to analyze large quantities of seeds produced by these plants, thus making it possible to quantify the movement-flow of pollen between the rice plants. All the results found in the most recent experiments and where the gene flow was analyzed using herbicide resistance or microsatellite marker as a marker, the crossing rate was also variable. However, they are lower than the rates previously reported in older works in that other methods were used to determine the occurrence of the crossing.

Final comments

The natural crossing rate between rice cultivars with similar cycle, plant height and panicle exposure, is less than 0.05%, decreasing as the distance between the donor plant and the pollen recipient increases, decreasing to zero from 04 m.

However, even so, after a few years of cultivation, this low percentage may be the cause of the appearance of resistant red rice plants to such a degree, threatening the effectiveness of the technology. A concrete fact currently occurring in rice fields where other technologies are being launched on the market to combat red rice.

The fight against weeds with their peculiarities of genetic diversity and gene flow, should include several tools and these will evolve over time.

Part of the doctoral thesis of Hector Vicente Ramires Benitez, defended at the Federal University of Pelotas.

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Investing in the seed business: Syngenta

The country has agribusiness as one of its strengths and, within it, the soybean and corn seed business involves more than R $ 15 billion per year, supplied by several companies dedicated to the creation, development and / or trade of superior materials to supply farmers and the society. In this matter, we will address the contribution of the Syngenta company in the country for these two species.

The company Syngenta (seeds) invests hundreds of millions of reais in research (creation and development of cultivars) per year in Brazil, making available to the farmer more than 20 corn materials and about 15 soy materials per year. The research structure consists of three experimental stations for corn and four for soybeans, being assisted by more than 400 sites for the performance evaluation of the materials.

It is emphasized that a large part of the crops are carried out in a tropical climate region, with the need to develop materials specifically for the country (Brazil is practically the only country of expression in the cultivation of soy and corn in a tropical climate). In short, the genetics of materials is developed in the country, involving structure, personnel and financial resources, as previously mentioned.

The company has two seed brands well known to farmers: Nidera, which works with soybeans and corn (stronger in soybeans) and NK, which also works with soybeans and corn (stronger in corn). The latter was practically reintroduced into the market, after research demonstrating the high concept it has with farmers.

Corn

The country has more than 17 million hectares under maize cultivation, 70% of which refer to the cultivation of safrinha (second crop), illustrating the strong work that companies have done to make corn viable in the tropical cerrado region (safrinha corn is very strong in this region). Currently, the productivity of the off-season corn in relation to the summer (classic) corn is practically the same.

The company's portfolio of corn hybrids in the two brands consists of 40 to 50 hybrids, depending on the place of cultivation, on-board technology, time of sowing and use (grain or silage). The largest number is in relation to the embedded technology, involving the type of hybrid whether single, triple or double, as well as biotechnological events of herbicide tolerance or insect resistance. In relation to this last characteristic, it is noteworthy that Syngenta has the most advanced technology among its peers, called Viptera, resistant to the attack of several aerial corn caterpillars. Corn suffers a lot from the attack of insects such as the cartridge caterpillar, among others.

It should be noted that the work on developing insect resistant materials is continuous, due to the genetic diversity of the insect, which without control can become a major problem. Therefore, research, as well as companies dedicated to the corn seed business, recommend the adoption of refuge (area cultivated with susceptible material). There is already an insect resistance event, which has no effect. The greatness of the companies' success is dynamic, with the need to place ever better materials on the market.

In corn, the company's market access is practically vertical, that is, it creates, develops the cultivars and sells its own seeds under its brands (Nidera or NK). However, it can license parent materials for seed producers to create their own materials (this possibility is diminished) and can also license corn hybrids for these.

> **“(...) the company has a program called + VALUE, which basically consists of guaranteeing seed lots with more than 95% germination to the rural farmer.”**

In terms of the quality of corn seeds, these are produced with artificial irrigation to guarantee production and harvested on the cob near the point of physiological maturity to guarantee their high physiological quality. These procedures allow us to serve the market efficiently, as the loss of 1% of the “Market Share” for not having seeds means 70 million reais, as well as placing only seed lots that have more than 90% germination on the market, despite law establishing a lower percentage.

The seeds are also tested for vigor and stored in acclimatized environments with a temperature of 10 ° to 12 ° C, procedures that help the company to deliver high quality seeds to the farmer.

Soy

Almost 37 million hectares are cultivated in the country with soybeans, in which more than 60% of this area is established with commercial seeds, meaning it is a business for several companies. As in maize, soybeans also had to be tropicalized and this was successfully accomplished by breeding programs, both private and public. The increase in productivity of Brazilian soybeans was higher than that of Argentina and the USA (countries also with a tradition in soybean cultivation) and is currently practically surpassing both countries, with 3.3t / ha. This demonstrates the professional success of those involved.

The company's cultivar portfolio is between 40 and 50 for each brand, however less than 10 of them represent more than 50% of sales. The cultivar Nidera 5909, for example, spent several years on the market with a market share of more than 10%. The company's staff is confident in the performance of the new cultivars containing part of the 5909 genome. Considering a productivity gain of 1.5% / year, it is estimated that these new cultivars, when they reach the market, will have a good acceptance.

Photo 1: Seed storage
Photo 2: Cultivar NA 5909 RG

In terms of market access, Syngenta makes use of verticalization and licensing of cultivars for seed producers, in a proportion of 45-55%, respectively. Considering the entire country, there are more than 80 seed producers that license cultivars from the company through a royalty payment, which varies according to the cultivar. The cultivars are different, depending on the brand and market access system.

The company's relationship with the rural producer is trustworthy, as it involves high sums of money, availability of new materials, promotion and quality of the seed being sold, which can often affect the concept of companies due to the low performance of the cultivar. In this sense, Syngenta has a program called + VALUE, which basically consists of guaranteeing seed lots with more than 95% germination to the rural producer. This initiative deserves recognition from the farmer, as he is the main beneficiary for the greater yield potential of a crop.

Seed treatment

The seeds need to have high quality and performance. The quality is obtained in the field, however the performance to overcome adverse conditions can be added to the seeds after application of post-harvest technologies. In this sense, seed treatment is used to increase the performance of seeds, the benefits of which have been known for decades, however its operation has made great progress in recent years, with the introduction of seed treatment in the industry (STI).

Difference between Seed Treatment in Industry and On Farm Seed Treatment

In Brazil, Syngenta was the first company to establish a center, in

> **The quality is obtained in the field, however the performance to overcome adverse conditions can be added to the seeds after application of post-harvest technologies**

2009, to disseminate and promote the benefits of quality seed treatment, especially the STI. In this center, known as the Seedcare Institute, the quality of the treatment is evaluated through various parameters, such as dust release, homogeneity of the cover, dosage, among other items, such as made in the physiological quality of the seeds and the compatibility of syrup. Visits to the center are frequent, mainly from technical groups.

The modern STI involves several products such as insecticide, fungicide, nematicide, micronutrients, "biological", inoculant, polymer, among others. Of this range of products, Syngenta has almost all in its portfolio, and in the case of the polymer and the inoculant, it works together with partners, which facilitates the diffusion of the TSI for seed producers and farmers.

The novelty of Syngenta for seed treatment is the biological product known as Clariva Sky, indicated for the control of nematodes in general, in soybean culture.

It is worth noting the assessment that Syngenta carries out with new cultivars or hybrids that are placed on the market, regarding the possible sensitivity that they may have to the main recipes of STI, in order to guarantee that the treatment can be done without affecting its physiological quality.

The STI is growing in the country, estimated at around 30% of the marketed seed, considering the process at the seed producer's facilities and at resellers. In addition, several large-scale farmers who cultivate a particular species have special handlers that resemble those used in the STI. Syngenta had a strong participation in the adoption of STI in the country.

Comment

Fortunately, Brazil has a legal platform covering seed production and trade, protection of cultivars, biosafety and patents, which allows companies to invest in science, technology, production and marketing of seeds, supplying farmers with superior materials.

Note - The preparation of the article counted, via interview, with Max Fernandes and José Veiga, both from Syngenta.

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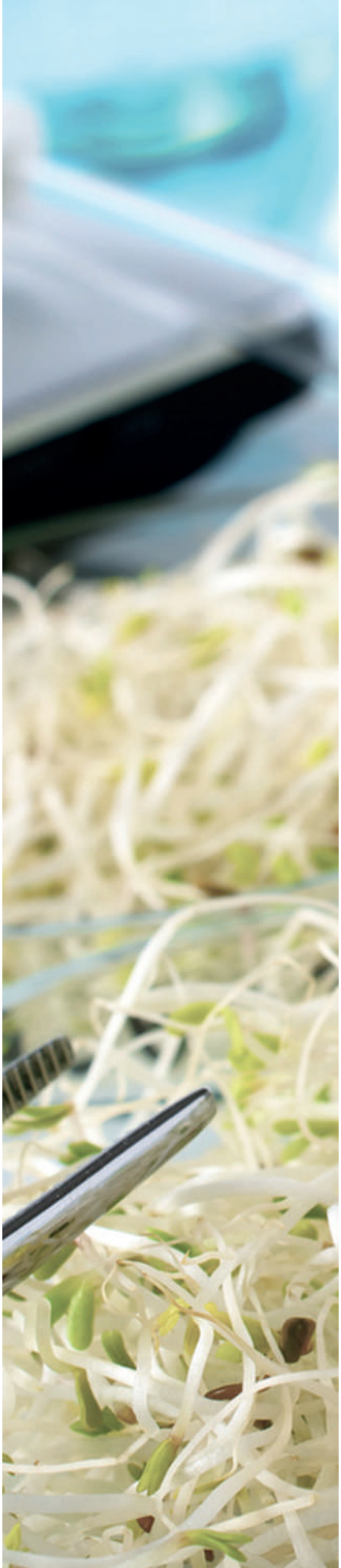

Innovating on the seed quality assessment

Seed quality is determined by genetic, physical, physiological and health factors. The physiological factor has been one of the most researched aspects for several years, due to the fact that the seeds are subject to a series of degenerative changes after maturity.

Nowadays, for seed marketing purposes in Brazil, it is required to have a germination test for physiological quality. However, due to the limitations of the time required for the germination test, interest in the last 35 years has been continuous for the potential of physiological properties and more recently, the biochemical properties of seeds, such as vigor indexes.

However, it seems unlikely that a single test: germinative, physiological or biochemical, would be appropriate under all conditions, even for a single species.

A vigor test should basically include:

a) record seed quality indexes more sensitive than the germination test;

b) separate seed lots in terms of performance potential;

c) be objective, fast, simple and economically viable;

d) be reproducible and interpretable in an objective way.

To have good receptivity among seed technologists, it must be reproducible and related to the field emergency, in addition to being fast, inexpensive, objective and easy to perform.

In view of these statements, several vigor tests have appeared over the years, mostly based on the coloration of the living tissue of the seeds due to changes in respiratory activity, in the case of the tetrazolium test or, on the permeability of the membranes through the evaluation of the electrical conductivity of the imbibition medium or, in the alterations in the exudate pH and potassium leaching, which is due to the release of metabolites during the imbibition of the seeds.

Few rapid tests involve more than one measurement principle, either through breathing, integrity of the limbs or even through images of seeds via X-ray. However, all of the tests mentioned above do not cover all the characteristics that an effective vigor test needs to have. Some require experienced analysts, others have an excessively long execution time and serve a limited number of species, others need sophisticated equipment and often do not meet the quality control dynamics of a seed producing company.

However, this paradigm may be overcome with the emergence of a new evaluation technology, with the use of specialized sensors that aim to quantify gases that, in some way, correlate with the vigor of seeds evaluated by the emergency test. This test is known as the "ethanol test", which stands out for being fast, practical and requires little knowledge about its operation, in addition to being low cost.

The ethanol test is based on the principle of anaerobic metabolism and on the integrity of cell membranes, where the seeds are subjected to a hypoxic environment, that is, without the presence of oxygen, forcing cells to repair their energy production via alcoholic fermentation, since breathing called "normal" does not happen in the absence of oxygen. Thus, when seeds are hypoxia for at least 30 seconds, they release ethanol to the external environment, and the speed with which this gas is released, has a close relationship with the integrity of the membranes.

But what is the relationship between ethanol production and seed vigor? Several studies carried out by students of the Graduate Program in Seed Science and Technology at the Federal University of Pelotas (UFPel), with various species (soybeans, beans, rice, quinoa and ryegrass), have shown that seeds from lots with low vigor in the initial minutes, release more ethanol than the most vigorous seeds, making the test able to stratify seed lots at different levels of vigor.

How is the ethanol test evaluated? The initial works were carried out with the adaptation of a breathalyzer, the same used by highway police. However, because it is an adapted equipment, which does not have its specifications aimed at assessing the quality of seeds and which needed a continuous air flow to perform a reading, it was extremely expensive to be able to break the breathalyzer diaphragm and obtain a reliable reading, in addition, the results were expressed in grams per liter of blood, something surreal when it comes to seeds.

How did the ethanol test become stable and easy to handle? After the observations raised in the initial works with the adapted breathalyzer, the research group of the Laboratory of Agrotechnology, of the Engineering Center of UFPel, with students linked to the Graduate Program in Science and Technology of Seed, started to create a prototype of an equipment that was able to measure the amount of ethanol that was released by the seeds during the anaerobic process, by means of a sensor and an air intake system that contained the ethanol released by the seeds. The initial tests went through the calibration of the equipment and its correlation of the results of the ethanol test with the traditional vigor tests, this will be the doctoral thesis of one of the authors. Also, the research group is looking for companies that may be interested in licensing the patent, which may be exclusive or not.

“(...) innovation in the evaluation of seed quality is necessary, with the improvement of classic tests as well as the creation of new ones.”

Thus, it is understood that innovation in the evaluation of seed quality is necessary, with the improvement of classic tests until the creation of new ones, with the use of embedded electronics and even artificial intelligence. This is a path of no return in which the seed area must be leading in agribusiness.

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The natural scarcity state of things

Reflections on the global scenario and challenges to agribusiness

With the intensification of restrictive measures to combat the pandemic around the world in the first months of 2020, many international institutions (such as FAO, ISF, APSA, ...) have expressed concern about the vitality of seed production and marketing, whose threat endangers food security in different regions of the planet.

According to Thomas Sowell, an award-winning North American economist, "The first lesson of economics is scarcity: there is never enough to satisfy everything for everyone who wants it." In the same sense, Lionel Robbins defines economics as "the science that studies human behavior as a relationship between goals and scarce means, which can have different uses."

In terms of tangible resources, we could divide them into three types: natural resources (land), which include minerals, water, flora, etc.; human resources, which are people's mental and physical efforts, and; capital resources, which include artificial items used in production. Each of these features is limited. However, people's needs and wants are always limitless.

Human Resources

Challenged by an uncertain socioeconomic future and a growing

population (estimated 9 billion people by 2050) with an ever-increasing demand for food, we are increasingly led to dominate the efficient use of available resources.

If we conducted an opinion poll on the most desired and, at the same time, scarce resource, there would be many suggestions that become increasingly drastic as we move into the 21st century. However, it is surprising to note that the most scarce and desired resource is still the same as millennia ago, time.

No matter how successful you are, lost time will never be made up and you will never have more than you have right now!

In the book "40 chances", Howard Buffet tells of the day he realized this great truth about time. "Many of us see agriculture as the continuous act of buying seeds, sowing, managing crops, harvesting and starting over with the next harvest. But when we remember the first day we went to the field and the last day that we will pass the key to the tractor to the next generation, we realize that we will have no more than 40 harvests (approximately) to grow something of value, adapt to the whims of nature and cheer for the best "!

With this in mind, we feel that we cannot afford to leave even a loose end on our farm, seeking to achieve maximum yield in each of these 40 chances to make a difference in our business.

During the green revolution from the 1960s onwards, the factor with the greatest impact on each crop was the valuable inputs added to crop management, such as chemicals and fertilizers.

Nowadays, germplasm has started to have an increasing impact on the final productivity of crops and continues to reach ever higher levels thanks to advances in biotechnology in favor of the development of new varieties and hybrids.

However, we can clearly state that success depends on a greater combination of factors, which are applied with a more efficient control of activities through the "IoT" (Internet of things) and precision agriculture from planning, planting, harvesting and final transport to the hopper.

"As a rural producer, we are always chasing the wheel, seeking to complete the next task while we are already looking to start another twenty or so projects that we dream of having time to complete on time", emphasizes Howard Buffet.

Natural resources

If we stop to think, we will remember the lesson we had at the beginning of our studies within the

São Paulo, 24 de abril de 1968

Escassez alimentar no Brasil

O Brasil terá de multiplicar por dez a sua atual produção de alimentos, ou será forçado a parar o surto de industrialização por falta de divisas para pagar o crescente volume de importação de alimentos, segundo relatório apresentado pelos delegados brasileiros à IV Conferência Latino-Americana de produção alimentar, que se realizou em Buenos Aires.

O encontro, patrocinado pela International Mineral Chemical Corporation, reuniu representantes do Brasil, Chile, Colombia, Costa Rica, República Dominicana, México, Venezuela e Argentina, visando principalmente estabelecer uma política coordenada a fim de deter a escassez de alimentos desta região do mundo, considerada uma das áreas mais famintas do globo.

A dieta alimentar do homem brasileiro é uma das mais baixas do mundo e o surto de industrialização dos Estados do Centro-Sul e do Nordeste brasileiro só virão agravar o problema, ao proporcionar um aumento das rendas da população urbana e uma demanda cada vez maior de gêneros alimentícios, a não ser que a produção agrícola acompanhe êsse desenvolvimento.

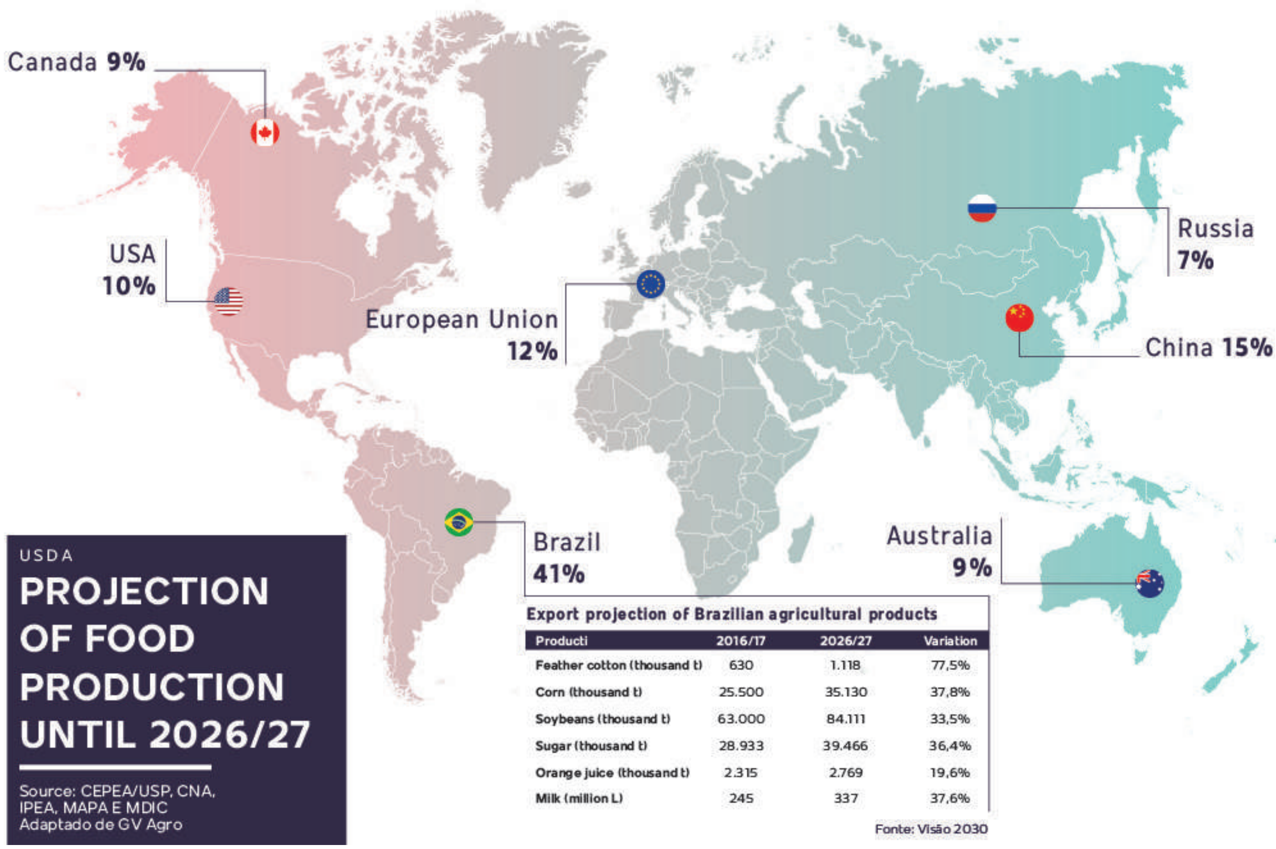
Report from the newspaper "O Estado de S. Paulo" on April 24, 1968 school, which taught us that our only source of energy is the sun. Our planet is located at an ideal distance to take advantage of the energy resources provided by the sun without excessive or insufficient exposure to life on earth. All the rest of wealth and food derive from this source of energy, generating the entire food chain that we know from the initial photosynthesis of plants.

Within this area of natural resources, there are several commodities and inputs which threaten society with potential limitations in the near or distant future.

Brazil has greatly expanded its agricultural activity in recent decades, becoming one of the main producers and exporters of soy in the world, for example. This growth is clearly due to efforts to enable production on large tracts of land in the "cerrado", whose topography in general, always presented good possibilities for the use of mechanized agricultural practices, since the relief is generally flat or of gentle undulations, but with different types of vegetation and a seasonal tropical climate with a pronounced dry season of 4 to 6 months per year.

In the past, the main obstacle to the development of agriculture in the "cerrado" referred to the low natural fertility of the soils, due to its acidity, high aluminum content, low concentrations of calcium and magnesium and, in the great majority, poor assimilable phosphorus. Norman Borlaug, a Nobel Peace Prize researcher and considered the "father of the Green Revolution", once said that "no one thought that these soils would ever be productive" and, after this feat, considered it the greatest achievement of agricultural science in the 20th century.

For this, it is essential to mention the contribution of Professor Alfredo Lopes Scheidt from the Federal University of Lavras (UFLA), whose extensive research under the "cerrado" soil allowed the adoption of techniques that promoted the increase of its fertility, as liming,



Export projection of Brazilian agricultural products

Producti	2016/17	2026/27	Variation
Feather cotton (thousand t)	630	1.118	77,5%
Corn (thousand t)	25.500	35.130	37,8%
Soybeans (thousand t)	63.000	84.111	33,5%
Sugar (thousand t)	28.933	39.466	36,4%
Orange juice (thousand t)	2.315	2.769	19,6%
Milk (million L)	245	337	37,6%

Fonte: Visão 2030

plastering, phosphating, potash and application of micronutrients.

However, not all factors are under full control of the rural producer. Being an activity mostly conducted in the open, the dependence of culture on the vagaries of nature and the climate are still extremely significant.

In this 2019/20 harvest, the south of the country experienced bitterly the impacts of drought on summer crops, whose drought caused enormous losses in the production of large crops such as soybeans and corn, mainly. This scenario exposed a recurring problem in global agriculture, the limited amount of water.

According to data from APROSOJA, Rio Grande do Sul suffered an estimated 40% drop in soybeans and 26.3% in corn (data from EMATER).

According to ABIMAQ data, less than 27 thousand of the more than 360 thousand properties in RS have irrigation systems. Of the total 21.7 million hectares of production, only 6% rely on water storage and irrigation technology, being always susceptible to the scarcity of rainfall in the region, which was 56% below normal for the same period in the region (according to INMET data between November / 19 and March / 20).

Agricultural activity demands approximately 70% of the fresh water used in the world, being one of the factors of less control in the hands of the producer, who even investing in irrigation projects, does not have full guarantee of access to this resource in drastic situations of drought in many locations in Brazil.

In view of this scenario, increasing efficiency in the use of resources is imperative for the success of agribusiness as a whole. That is why the growth of precision farming practices, the control of activities and the evolution of digital technology within farms has been rapid in recent years. The scarcity of several resources and, mainly, of the limited window of time available to the producer, does not allow waste related to rework, application failures, unbalanced plant nutrition and any types of inadequate management of the culture in the 21st century.

The challenges generated by the combination of the current macroeconomic crisis to face the pandemic and recurring national credit problems further aggravate the situation of producers affected by the drought in this last harvest, which in turn, will directly impact on capital resources.

During the past few decades, many nations, including the fastest growing developed countries in the world, have contracted massive debts in relation to their annual GDP (Gross Domestic Product). According to data from the IMF (International Monetary Fund) of 2018, only Japan, the USA and China represent more than 57% of the global debt, totaling more than 40 trillion dollars. With the worsening of the COVID-19 pandemic earlier this year, several countries have had to increase their domestic debt even more to ease the varied socio-economic impacts of the virus on society.

In the case of Brazil, the debt approaches 88% of GDP, that is, 8.5 trillion reais (according to 2018 data), placing the country among the 10 most indebted nations in the world.

There is only one way to reduce each nation's debt, which depends directly on the increase in GDP through industrial production. Unfortunately, developing countries like Brazil, still depend significantly on agricultural production to generate wealth and contribute to national GDP.

Between 1990 and 2019, Brazil's agricultural balance increased almost tenfold, reaching US $ 89.33 billion in the last year, values that have contributed to the balance of the country's external accounts.

The organization and the intense process of modernization of the agribusiness production chains made the links before and after agricultural activities, such as the production of inputs, processing and distribution, present an increasing importance in the Gross Domestic Product (GDP).

In 2019, the sum of goods and services generated by agribusiness reached R $ 1.56 trillion or 21.1%

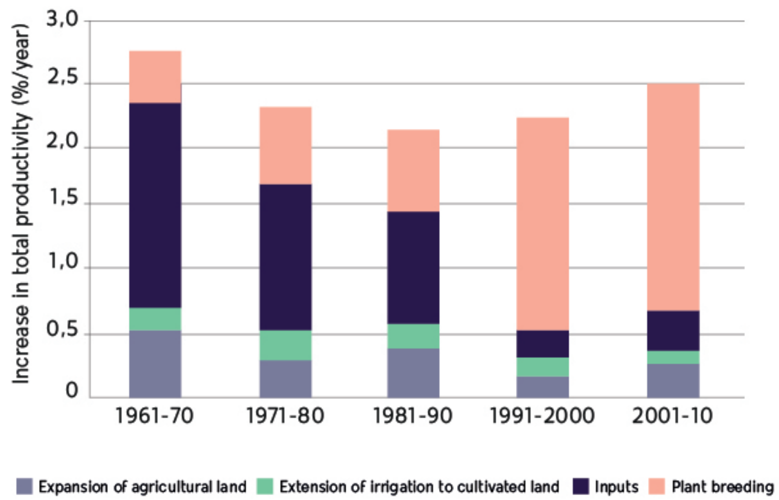
of Brazilian GDP. Among the segments, the largest portion is in the agricultural sector, which corresponds to 74% of this value (R $ 1.07 trillion), with livestock corresponding to 26%, or R $ 375.3 billion.

By 2050, the world demand for food, mainly from China and India, will have increased significantly and, Brazil will have a great pressure to establish itself as one of the main suppliers in several products for export.

"(...) it is essential to mention the contribution of Professor Alfredo Lopes Scheidt from the Federal University of Lavras (UFLA) from the 1970s, whose extensive research under the cerrado soil allowed the adoption of techniques that promoted the increase of its fertility"

Fortunately, Brazil is rich in human and natural resources, with enormous growth potential in all areas of the industry, including agriculture and livestock. According to Paulo Hermann, president of John Deere in Brazil, "Brazilian agribusiness is very well structured, being the only country that has the potential to double its production, maintaining the preservation of 66% of the national territory, mainly through the recovery of areas with pastures degraded.

IMPACT OF DIFFERENT FACTORS
in the productivity of the main crops in the world



CONCLUSION

The recent trajectory of Brazilian agriculture is the result of a combination of factors. The scenario for this is a country with an abundance of natural resources, with extensive arable areas and availability of water, heat and light, essential elements for life. But what has made the difference in these last 50 years has been investments in agricultural research, which have brought advances in science, appropriate technologies and innovations in several areas of agribusiness.

The transformational power of a technology depends on the economic and political context, the needs of society and its socioeconomic conditions, the speed of which could be significantly increased with the appropriate incentives, regulations and social licenses. These, in turn, require constructive stakeholder dialogue and clear transition paths.

The Green Revolution provides a good example of these systemic changes, as it allowed for a rapid increase in crop yields, increased consumption and reduced malnutrition at a speed and scale never seen before in the world.

The first lesson of economics is scarcity, that is, if nothing is done, we will have nothing! If the ship with fertilizer does not cross the oceans, the seed does not fall to the ground in a timely manner, the farmer does not harvest before the next rain and the grain does not reach the customer, humanity will suffer even more to reach the growing demand in the coming years.

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The impact of the densimetric table

A seed batch must have similar physical, physiological and genetic characteristics, so that the sampling, for analysis purposes, is representative. Thus, among the procedures that the seed producer uses to obtain a homogeneous seed lot, there is an appropriate sequence of equipment used in the improvement.

When considering the wide variety of seeds sold, we quickly perceive the great challenge of dealing with all kinds of damages, impurities, imperfections in general (such as maturation) and so many other physical, physiological and sanitary characteristics inherent to each species and cultivar, being managed during the post-harvest stages such as processing.

Each equipment within a UBS (seed processing unit) performs its separation function through some physical characteristic. Thus, the sieves separate by size (width and thickness), the cylinder by length, the spiral separates by the shape, while the densimetric table separates the materials by the difference in density. There is also an optical separator that separates by color. In this article we will cover the densimetric table (also known as the gravity table).

The physical difference in density can be between the seeds and an impurity (crop residues, broken seeds, weeds, among others) as well as between the seeds of the same cultivar, the latter having a close relationship with the physiological quality of the seeds. Seeds of lower density tend to have lower physiological quality.

The equipment

The use of the difference in density for separating undesirable materials from the middle of a seed lot is a long-standing one, in which water was initially used as a means of separation, since "good" seeds submerge while those of lower quality (density) remain on the surface. This process has been used until recently in rice and onion seeds. The drawback of using water as a means of separation is that the seeds absorb water.

In this way, the densimetric table was developed using air together with the vibration and lateral inclination of the table to separate light and heavy materials. The air stratifies the materials, while vibration and inclination guide the materials to different outlets of the equipment.

The table clearly stands out as one of the equipment with the most technology and complexity within the processing stages, requiring its operators to have specific training so that they can carry out the process efficiently.

Disposition

There are many cases whose equipment is placed in the initial stages of the processing line, that is, just after the MAP (air machine and sieve) and even before the seeds pass through the classification spirals and sieves or even cylinders (depending on the species). However, this can be a serious planning mistake, as there is variability in seed size, impurities and other deformed seeds, the densimetric table will not act with the necessary efficiency to separate low density seeds, which significantly impact physiological quality of the final batch.

There is an extensive range of situations and problems in a batch of seeds which the densimetric table will be able to provide solutions, separating the undesirable materials from the batch, however if there are other aphysical differences besides the density, it will not be possible to provide the desired attention to these situations during the table regulation process, which involves several factors such as air force, lateral and terminal inclination, seed flow, vibration and discharge. For this reason, it is always recommended that there is at least one table present in the last stage of processing.

Regulation

One of the most practical and quick ways to check the regulation and efficiency of the equipment is to collect a determined volume of the separated seeds in each part (spout) of the table discarding area, then weighing them. The weight difference of each sample of the same volume must, in most cases, present a minimum variation of 5% between the heaviest (selected) and the lightest (discarded) seeds.

For soybean seeds 5% is fine, however for rice and wheat seeds this difference must be greater than 7%, as in rice there may be seeds that are not completely "full", showing a great difference in density in relation to completely "full"seeds. While in wheat, the seeds are highly susceptible to field deterioration affecting their weight. Grain wheat is even commercialized based on its hectolitric weight, which has a close relationship with density.

In his doctoral thesis, Professor Leopoldo Baudet Labbe recommends that the corn seed industry should use the minimum difference of 8% in volumetric weight between the extreme fractions (heavy and light) on the densimetric table. If the difference in weight between the fractions is small, it is likely that the seeds are just walking around the table.

Another aspect to be considered in the settings of the

Some research examples relating the quality of seeds segregated in the upper portion of the table in relation to the initial sample

	Species	Increased germination (%)	Reference
FORAGES	Pensacola	15	Peske, S. T., 1976
	Brachiaria	19	Jeromini, T. S., 2017
	Ryegrass	20	Vergata et al, 2019
	Sorghum	11	Cortes, 1987
	Grass mombasa	12	Melo et al, 2016
	Forage turnip	7	Nery et al, 2009
GREAT CULTURES	Rice	19	Pereira et al, 2012
	Cotton	11	Justus et al, 1965
	Soy	8	Almeida, 2016
	Corn	7	Baudet & Mistra, 1991
	Wheat	12	Shinzel R.L. 1983
VEGETABLES	Broccoli	4	Gadotti et al, 2006
	Carrot	7	Nascimento & Andreoli, 1990
	Beans	11	Mertz et al, 2007
OTHERS	Coffee	4	Giomo, G. S., 2003 (Tese)
	Tobacco	13	Gadotti et al, 2011
	Castor bean	19	Neto et al, 2012

Photo 1: Well-adjusted gravity table
Photo 2: Heavy and light rice seeds separated on the gravity table

densimetric table is that there will always be a disposal of seeds, considered as normal from 5 to 7% even with the best adjustments. If the disposal is higher than these values, special attention must be given, as it is poor management to discard quality seeds after a lot of work has been spent to produce them.

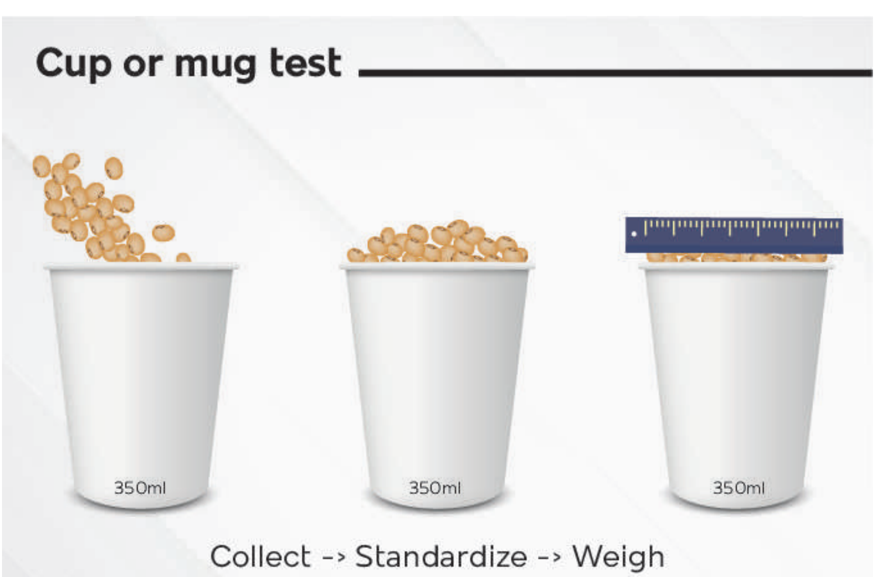
Physiological quality

It is recommended to always process all seed lots of all species, going through the densimetric table for both the cleaning benefits and the improvement in physiological quality.

In the case of soybean seeds, the greatest benefit is in the separation of seeds with damaged tegument, in which in the light fraction there will be greater concentration. On the other hand, in rice, wheat and corn seeds, for example, in addition to the improvement in the physical quality of the batch, there is also a marked improvement in the physiological quality of the batch. Another aspect is the health of the lot in which the most contaminated seeds tend to have a lower density and thus can be separated in the lower part of the densimetric table.

In normal seed lots, it is common to determine differences greater than 10% in the vigor of the seeds collected in the extreme fractions of the table. This difference in seed vigor translates into increased productivity of seeds of higher density, and this can be generalized for all species.

In terms of equipment used for seed processing it is considered that the gravity table is practically the only equipment that can improve the physiological quality of a batch of seeds. Another device is the optical separator to separate green soybean seeds.



Final comment

There are several models of densimetric tables on the market, such as rectangular, triangular, automated, with fabric cover, wire mesh, perforated plate, with dust collector, among others. There are even tables that do not need to be firmly attached to the floor, allowing their position on the second or third floor. However, all use air to stratify light seeds from heavy ones and vibration and inclination to affect the separation of seeds.

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Seed Analysis Bulletin: meaning and validity

The Seed Analysis Bulletin (BAS) is a document that expresses the results of physiological and physical quality analysis of a seed lot, issued by a Seed Analysis Laboratory (LAS), accredited by MAPA. The seed lots must be analyzed in LAS accredited by MAPA to be marketed.

There are currently 185 accredited LAS in Brazil, distributed in the Southeast Region (50), South Region (78), Midwest Region (50), Northeast Region (7) and none for the North Region of the country. The Official Seed Analysis laboratories (LASO) serve the MAPA inspection and are in the same regions, with the exception of LASAO / LANAGRO in the Midwest region.

Concepts

Seed analysis consists of technical procedures used to assess the quality and identity of a seed sample (representing a batch) and its results issued by a document, BAS.

The amount of seeds analyzed is, in general, very small, when compared to the lot size it represents. Therefore, samples must be taken with great care and in accordance with the methods established in the Seed Analysis Rules (RAS) or current regulatory instruction. Sampling may be carried out by an individual accredited by MAPA to carry out sampling (registration with Renasem) while the sample for inspection is carried out by MAPA's Federal Agricultural Inspector or by an employee of the state, municipal or Federal District administration, provided they are duly trained.

The time indicated for a sample to arrive at the LAS, since its collection, is 48 hours, with the most used packaging being cardboard. On the other hand, the weight of the sample varies with the species, being for large cultures, 1 kg.

What does BAS report?

The BAS is the document of proof of the quality of the batch, which also brings information about the identification of the LAS such as the logo, name, address, the species included in the scope of accreditation, number and validity of the laboratory's "Renasem" and, number of the ordinance accreditation.

BAS models for identification, certification and inspection purposes, as well as instructions for completing them, are present in Normative Instruction 40 of November 30, 2010. Laboratories, through the commitment to adopt and implement the Quality Management System, supported by the requirements of ISO / IEC 17025: 2017, develop reliable works that ensure quality, based on RAS (Brasil, 2009) and other applicable standards and legislation.

The results of the germination test, purity (pure seeds, other seeds and inert material) and determinations of other seeds by number are reported in the bulletins.

There are some exceptions, such as for bean (Phaseolus vulgaris) and cowpea (Vigna unguiculata) crops that require analysis of species and cultivar verification, described in Normative Instruction No. 45, of September 17, 2013. For seeds of Brachiaria forage of Brachiaria brizantha species; Brachiaria decumbens; Brachiaria humidicola; and Brachiaria ruziziensis and for mombaça grass (Panicum maximum), can be sold based on the viability results obtained by the tetrazolium test, according to the methodologies established by MAPA. As well as for annual ryegrass (Lolium multiflorum).

Minimum weight of the sample to be sent to the LAS, according to the botanical species

Botanical species	Weight (g)	Reference material
Pumpkin (*Cucurbita ficifolia*)	350	IN 42, 2019
Cotton (*Gossypium hirsutum*)	1.000	IN 45, 2013
Rice (*Oryza sativa*)	1.400	IN 45, 2013
Ryegrass (*Lolium multiflorum*)	60	IN 44, 2016
Brachiaria (*Brachiaria brizantha*)	360	IN 30, 2008
Brachiaria (*Brachiaria decumbens*)	200	IN 30, 2011
Coffee (*Coffea arabica*)	1.000	RAS, 2009
Bean (*Phaseolus vulgaris*)	1.000	IN 45, 2013
Soybean (*Glycine max*)	1.000	IN 45, 2013
Sorghum (*Sorghum bicolor*)	900	IN 45, 2013
Wheat (*Triticum aestivum*)	1.000	IN 45, 2013

Test validity

The validity time of the germination and reanalysis test varies according to the species and, depending on the genetic diversity as to the storage potential, as there are species with long, medium and short life. These differences make the germination test validity and reanalysis for a greater number of months for some species when compared to others. In long-lived species, the germination test is more valid.

For the commercialization of seeds of species of the great cultures registered in the National Register of Cultivars (RNC) the validity of the germination test varies from 6 to 12 months and the re-analysis from 4 to 8 months (see illustration).

The test validity for vegetable, condiment, medicinal and aromatic seeds, alternates from 12 to 24 months in conventional conditioning and in airtight packaging, respectively, with the same validity time for the reanalysis of the test (IN 42, 2019).

When using the tetrazolium test instead of the germination test, it must be clearly indicated by expressing its result in percentage of viable seeds, both in the seed packaging, as in the certificate or in the term of conformity of the analyzed seeds.

BAS records

Following is the identification and sequence of tests contained in BAS:

1) Purity: it is the first analysis to be performed in the laboratory. It determines the mechanical composition of the sample, identifies

Validity of the germination test and reanalysis according to the botanical species

Botanical species	Validity (maximum in months)*	
	Germination analysis[1]	Germination reanalysis
Cotton (*Gossypium hirsutum*)	7	4
Rice (*Oryza sativa*)	10	8
Peanut (*Arachis hypogaea* L.)	8	4
White oats (*Avena sativa* L.)	10	6
Ryegrass (*Lolium multiflorum*)	6	4
Canola (*Brassica napus* L.)	6	4
Barley (*Hordeum vulgare* L.)	6	4
Bean (*Phaseolus vulgaris*)	6	4
Sunflower (*Helianthus annuus* L.)	6	4
Maize (*Zea mays* L.)	12	8
Soybean (*Glycine max*)	6	3
Sorghum (*Sorghum bicolor*)	12	8
Tobacco (*Nicotiana tabacum* L.).	24	12
Wheat (*Triticum aestivum* L.)	8	4

*In all classes of seeds (Basic, C1, C2, S1 and S2);
[1]Excluded the month in which the germination test was completed.

different species of seeds and the nature of the inert material. The final result is expressed as a percentage of seeds; other seeds and inert material (materials that do not fall into the two previous categories, for example: leaves, stems, straw, earth, clods, dead insects, cariopses without embryo, legumes without tegument, etc.);

2) Determination of other seeds by number: estimates the number of seeds (including bulbs and tubers) of other species in the working sample. Quantifies the presence of all other seeds present in the sample: cultivated, wild, harmful, prohibited and tolerated. It is expressed in number of seeds of each species found in the sample (number / mass of the sample) and indicates the botanical name of the species, when it is not possible to report the genus or family. Ex: Kidney beans - Vigna unguiculata - 01 / 1000g;

3) Verification of species and cultivars: determines the percentage of seed in the sample that is in accordance with the species or cultivar indicated and the number of other cultivars in a sample taken from the portion of pure seeds.

4) Germination: determines the seed value for sowing, recording maximum germination potential. It is conducted in favorable and standardized conditions of humidity, temperature, substrate and light. This is necessary so that the results can be reproduced and compared, within tolerance limits. The results show the percentage of normal and abnormal seedlings; hard, dead and / or dormant seeds.

5) Tetrazolium: fast method that estimates the viability of seeds, based on the alteration of living tissues in the presence of the tetrazolium solution.

Final comment

Brazil has 185 LAS to check and certify the quality of the seeds to be marketed, the main ones being soybeans, corn, wheat, rice, cotton, sorghum, forage, vegetables and ornamentals, which does not seem to be much to meet the demand, because considering only the soybean crop, in which the commercialization of 100,000 20t lots is estimated (maximum is 30t), an average of 540 analyzes per laboratory / year will be necessary.

As discussed in the text, there are reanalyzes, usually moments before sowing, indicating that this number can be doubled only for soybeans. Thus, considering the other species, including some (forage) with more work to conduct the tests, the LAS in the country are in a tendency to increase. Some are offering vigor analysis and registering with BAS, according to the law.

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Agriculture in Germany

Germany is the second biggest producer of agricultural goods in the EU, just after France, with the value of its agricultural production estimated in € 58 billion. In 2019 the 16,6 million/ha cultivated area was occupied by approximately 28.500 farms, which 71% was described as arable land, 27,8% as meadows-pastures and 1,2% perennial crops. 90% percent are family owned farms, managing about 65% of total farmland.

Mean farm size rose from 7,5 ha in the 1960's to 62,3 ha nowadays. After the Reunification of Germany, the number of bigger farms climbed the ladder, with former cooperatives (dating back to East Germany) having to change their legal status to partnerships. 1.500 farms with at least 1000 ha manage over 15% of total arable land.

Cereals are the dominant crop in 60% percent of fields, followed by fodder crops with 19% and other vegetables, as shown in the table below. Animal husbandry is not targeted in this article.

Future perspectives

Following the modern production methods of today, one farmer can produce food for 155 people, a huge increase of potential compared with the 10 people in 1950. Sustainable use of inputs on new plant varieties like modern plant protection measures and targeted use of fertilizers are responsible for this success. In the future, farmers will need to use the limited given farmland to even more effectiveness. The Industry will provide help with their tools for precision farming as well as robotization and automation on the fields, even for small sized farms.

On the other hand, there is a growing number of farmers who switched to eco farming, after the trend was encouraged by subsidies in the 1990's. It fits to consumers opinions on a better health value of "eco products" as the shortening of "bio" on fresh processed goods assimilates a feeling of healthier nutrition in the brain of costumers. This thinking was and is still emphasized by the spread medias meaning in general, often not based on scientific results.

Public expectations on farmer's production – EU regulations

Meanwhile in Germany, an extraordinary development has influenced the ministries of environment and agriculture. The directives appointed by the EU in regard of these areas indicates possible changes ahead.

According to the EU, Germany's agriculture may be responsible for the reduction of plant and animal (insects) varieties, pollution of rivers and groundwater (P, N – residues of pesticides and others), and also, to some extent, climate change (emissions of NH_3).

Today's farmers shall spend their time having individual discussions with consumers to clarify their opinions on what agricultural industry did not achieve over decades. For example, pointing out that chemicals for plant protection are the best investigated chemicals regarding their influence on living environment under the precondition, of course, that they are used following the labels and procedures.

Even more than up until now, subsidies to EU farmers will be bound to achievements made by farmers regarding the environment. Slogans like "Green Deal" and "From Farm to Fork" stand for these initiatives. The Green Deal proposes a reduction of pesticide use and mineral fertilizers of 50% and 20%, respectively, by 2030, for example.

These ambitious perspectives have caused an expected strong reaction by farmers organizations. Since last year, protest campaigns have occurred, with truck convoys running directly to government towns and cities. The reaction of officials more than corroborate to the feeling of huge inability and misunderstanding towards agriculture and its subjects.

Whatever Germany does as an industrial country, it must subordinate its agricultural policy to the benefits of the Country's economy and to the EU directives. There is one simple explanation for such actions to be taken: 77% of Germany's exports of agricultural goods and over 50% of its industry exports go straight to the EU common market.

Cultivated area and productivity in Germany in 2019

	Area (1 000 ha)	Productivity ton / ha
Cereals	6 372	7
Wheat	3 118	7,4
Rye	636	5,1
Barley	1 709	6,8
Oats	136	4,1
Triticale	358	6,1
Corn -grain	416	8,8
-silagem	2 223	39
Potato	272	39
Sugar Beet	409	73,7
Canola	853	3,3

Source: "Statistisches Bundesamt"

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Double interference in seed quality

The temperature and relative humidity of the air are climatic variables that influence the physical, physiological and health quality of seeds. Excesses or deficits create stimuli for the diversity of responses of plants and seeds, at different crop stages. One of the ways to avoid climatic risks when establishing the crop to produce seeds, is the sowing schedule and, even so, there is a risk of bad weather, not always captured by climate forecasting models. And, in fact, information inconsistencies have been happening quite often.

There are subdivisions on the phenological scale, called phases or subperiods of growth and development, which can be affected in different ways, depending on your physiological moment. It has its importance, since the vegetative phase (germination, emergence and growth of the aerial part and the roots), can be frustrated with some adverse situation, signaling probable unevenness, depending on the intensity and duration of the period. In the reproductive phase (flowering, fruiting and maturation), the sensitivity of the plant to climatic factors can directly affect the quality of the seed.

In the production of soybean seeds, some questions have been very frequent recently: why did the seed dehydrate so quickly and in the past it didn't? Why is green and / or greenish seed appearing so often?

Anyway, it is well known that science has no conclusion and the answer to a question can raise a new one and for any and all questions it is essential to find technical arguments and facilitate with examples, in order to understand this more complex scenario, which I believe it will be our shadow from now on. At what point is climatic variability controlling factors for so many undesirable indicators for seed quality?

What factors regulate the orderly maturation of soy cotyledons during seed development? It is known that the maternal environment plays an important role. So, let's look back. In the last harvests, especially in the 2018/2019 crop and in the 2019/2020 crop, periods with thermal excess were observed, often associated with lack of water, during development periods, with more pronounced consequences in the seed filling phases and during physiological maturity. In these stressful situations, the absorption of nutrients may be cut and the development of plants may be impaired (photosynthesis and respiration are inhibited under high temperature). The seeds can accelerate the maturation, favoring, in general, the appearance of groups of immature seeds and with greenish cotyledons. In soybean with an indeterminate growth habit, the emphasis is greater because the effects of maturity are evident through the extension of the flowering period. In this context, excessive ripening may occur in the vegetables formed earlier, a circumstance harmful to quality, because deterioration has a strong possibility of occurring while that seed is still in the plant. Studies have shown that in conditions of high temperatures and water deficiency, seeds ripen faster than usual, interfering with the activity of enzymes that participate in routes that degrade chlorophyll, especially chlorophyllase. This is a reason for chlorophyll retention in cotyledons.

In this sense, as a rule, altering the integrity of the cell membrane is considered as being one of the first signs of deterioration. This time, we will understand how the explosive double, which causes stress, is related to the permeability of the membrane systems, allowing the most accentuated loss of solutes.

Renowned physiologists have reported that stress caused by water deficit leads to the expression of sets of genes involved in acclimatization and adaptation to stress. These genes act as intermediaries for cellular responses. A large group of genes regulated by osmotic stress have been discovered in embryos that naturally dehydrate during seed maturation. These genes encode proteins called late embryogenesis abundant proteins (from English LEA, late embryogenesis abundant), which can play a role in protecting the cell membrane. The transcription of the genes that encode these proteins increases in the desiccation stage, which is a characteristic of most genes responsive to abscisic acid - ABA. Thus, the synthesis of most LEA proteins is under the control of ABA. This phytohormone has the function of inhibiting the machinery responsible for the hydrolysis of reserves in the phase prior to seed maturity. Osmotic stress typically leads to the accumulation of abscisic acid. LEA proteins are hydrophilic and bind strongly to water. Its protective role may be associated with the ability to retain water and prevent, during dehydration, the crystallization of important proteins and other molecules.

On the other hand, the high temperature reduces the membrane stability. The excessive fluidity of membrane lipids at high temperatures is related to loss of function. At elevated temperatures, there is a decrease in the strength of hydrogen bonds and electrostatic interactions between polar groups of proteins in the aqueous phase of the membrane.

“(...) altering the integrity of the cell membrane is considered as one of the first signs of deterioration.”

In several studies involving soybean seeds, obtained from rapid maturation and drying and with partial degradation of chlorophyll, the leaching of a large amount of inorganic phosphate, sugars and soluble proteins during imbibition was verified, when compared to the seeds that dried slower.

Therefore, the interference of thermal and water stresses during desiccation (dehydration) have a fundamental link with the quality of the seed, as they have the potential to cause severe damage to the membrane system and other cellular constituents, to cause disruption and to trigger the entire deterioration process

BIOTECHNOLOGY

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GMO or Non-GMO: Europe's stalemate

The European Food Safety Authority (EFSA) recently held a worldwide public consultation on the regulation of products generated from Innovative Precision Improvement Techniques (TIMP), specifically SDN (Site-Directed Nucleases) systems.

SDN systems are how the ways of using genome editing techniques are classified, such as the CRISPR-Cas tool, and how the final product is presented. The type of technique used has determined whether or not the final product will be considered a GMO under the legislation of each country.

In the SDN1 application, the naturally occurring DNA repair in cells (Non Homologous End-Joining; NHEJ) is explored to introduce simple random mutations (substitutions, insertions and deletions) by systems such as CRISPR-Cas, TALENs or Zinc Fingers Nucleases, which cause gene silencing after breaking DNA.

In the SDN2 approach, a template DNA is also used to introduce a change in the sequence of nitrogenous bases of the DNA at the target site that suffered the break of the double strand of DNA, exploring another natural path of repair, directed from a fragment of DNA of the species itself.

In the SDN3 approach, one can explore both the NHEJ and the HDR to insert one or more fragments of DNA containing sequences necessary for the expression of a gene at a specific location in the genome.

Brazil, Argentina, Canada, Chile, Colombia, USA, among other countries, are among the first to have legislation that regulates the safe use of gene editing techniques. Brazil has made a similar assessment to other countries in the Americas, mutations produced by SDN1 systems cause inactivation of the target native gene (knockout). This allows, precisely and without the inclusion of DNA from other species in the final product, the modification of characteristics of interest. In this case, the product does not fit as a GMO under the Biosafety Law, in view of the Brazilian legislation to exclude products obtained by Mutagenesis as GMOs. Similarly, as with products obtained by classical breeding, or by mutations induced by different external factors, or even by errors during DNA replication.

In this way, the mutations produced by SDN1 systems have received the same evaluation criteria used in the mentioned processes. The ever deeper knowledge of the genome of different species has allowed its editing with much more precision when compared to mutation systems induced by radiation or chemical products as has been done in the development of commercial varieties for decades.

Genome editing systems type SDN2 may or may not be considered as GMOs under Brazilian law in case-by-case analysis. They are systems similar to natural mutagenesis because they alter small portions of genomic DNA, as occurs in genetic improvement programs, or caused by chemicals / radiation, or even in the natural differentiation of germplasm from a species collected in different locations. The main differentiating factor in considering products obtained by SDN2 systems as Non-GMO has been the presence or absence of DNA from outside the primary or secondary gene pool of the target species.

SDN3 systems, on the other hand, due to the complexity of the introduced genetic elements, normally fit as GMOs, always depending on a case-by-case analysis, and the origin of the DNA used.

Unlike the Brazilian Biosafety Law that excludes Mutagenesis from the scope of GMOs, in a decision of the Court of Justice of the European Union on the subject, it was established that in the European Union Directive 2001/18 / EC, on the analysis of risk of GMOs, applies refer to products obtained by “new mutagenesis techniques”, that is, SDN systems.

Innovations in the field of genetics must be made respecting the basic principles of biosafety. However, legislation cannot stop technological development, or leave the possibility of developing biotechnology-based products with few institutions and companies, as occurred in the case of transgenics, considering the expensive and time-consuming approval processes created by each country.

As the SDN1 and SDN2 systems simulate / imitate mechanisms of induction of genetic variability that occur constantly and frequently in nature, their detection in products that have had their genome edited is practically impossible, if the location where the mutations were made is not known. The European Union itself in the report “Detection of food and plant foods obtained by new mutagenesis techniques” recognizes that products whose genome has been edited may be indistinguishable from products altered by natural processes or by conventional techniques of reproduction.

It is important for the European Union to review the decision of its Court of Justice, as apparently the EFSA has done on scientific grounds. The balanced development in global agribusiness depends on the harmonization of the legislation of the WHO member countries in the biosafety laws.

Food exporting and importing countries must have laws that reflect and welcome technological progress, maintaining the quality and safety of food, but also allowing for greater diversification of the participants in the production chain.

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The human will prevail over the digital

Each sector has its specificities and reacts differently to the challenges. In this regard, one of the lessons we must learn from the pandemic, as a country and also as a citizen and entrepreneur, is that we can never depend on a single source of revenue.

This time, agribusiness is saving the country. It did well and keeps doing it. In fact, it has been doing it for a long time. Since it decisively began to professionalize in the early 1990s, it has become more refractory to the bumps of the economy and has positioned itself as an important pillar to the disarray and confusion of the market and internal politics.

To the nation's general joy (and it's not just rhetoric) we have evolved daily, safely and continuously. The current term is agriculture 4.0. The ubiquitous digitalization of agribusiness, which according to experts in the technology field, comes with everything, along with the virtualization of relationships.

FOLLOWING THE VIRTUAL FLOW

But, regarding the future of interpersonal relationships, I have serious doubts. I explain why: now, with the decrees of seclusion and isolation, it seems that the world has become virtual. Everyone is looking for online alternatives to make their current businesses not succumb, or even create new ones. We strive to stay connected with friends and colleagues using technology resources.

There is a current desire to make us believe that the world has changed and that now everything will be virtual, regardless of the sector in which we operate. Reassure us that a new world is emerging. That we will isolate ourselves behind machines and screens trying to become electronic humans and capable of touching life with low interaction. And they swear that we will live happily still, more efficient and effective.

It is obvious that the world will no longer be the same and that a great deal will be accomplished by neglecting physical proximity, intermediated by technology. Different and new possibilities are opening up and being designed.

Just look at the flows of venture capital. First note that from January to the end of April they had total contributions of around 480 million dollars. In other words, a 20% growth compared to the same period last year, which is excellent news.

But the big question is: where are they migrating to? And there it is clear that the main focuses are distance learning companies, deliveries and hygiene and health products. It clearly demonstrates that technology and flexible companies have taken the lead in this race, or at least, they are the main current bets of venture capital.

WE WILL NOT BE HAPPY REMOTELY

Even so, I do not believe in this world at a distance. Not that way at least. And more: I will fight for that not to happen the way it is being designed for us to be. I will do my part.

I guarantee that we will not be happy at a distance. At least I won't be. The farm will not be. We are a gregarious being. We like contact, the experience lived and felt. We need cuddling and genuine attention. At least one tête-à-tête. So personally, I don't believe in that physical distance for a long time. We will not stop being human. We cannot stop being.

They are things of age, of nostalgia, my detractors would say. But I realize daily in my circle of friends, colleagues and acquaintances that this is not the case. I see my daughters, for example, distressed and perhaps even stressed because they cannot embrace their colleagues, friends and teachers. Of having to take virtual class daily. Although interactive, but bland. No physical interaction. And they are young people who love technology.

I see colleagues and friends reticent and prevented from having a good tea or a hot coffee, made on the spot, with their customers or suppliers. Social media and technology solved almost everything. But the complicity of prose to the ear, the embrace, the handshake is lacking. Genuine networking is born out of that moment.

As Amanda, my youngest daughter, says, when giving me a long hug, in one of her behavioral balances, in this new reality that we are living: a hug calms me father. I feel relieved. I thought: how to make this exchange of energy virtually.

Bárbara, my eldest daughter who is not used to long journeys by car, because she understands them is tiring, has also manifested a contradiction in her feeling: she is eager to travel. Go out. Go on the road. He wants to be gone for days. Another shift in the opposite direction to the dictatorship of digital isolation.

> **“(...) it is unquestionable that we will evolve a lot in connections and in new virtual businesses”**

AGRIBUSINESS IS INTERACTIVE, FLUID AND INTERPERSONAL

I think about business and events. In the month of June, I was one of the mediators of “Two Weeks of Agro”. A set of 8 lives organized by RC Consultoria and Nextbusiness, with 12 professionals who are national authorities in their areas. Obviously, everything virtual. An absolute success, with little mobilization, logistics and at very low cost. Something previously thought out.

But I know that the participants just took advantage of the speakers' knowledge. They lost the rich and true networking of face-to-face events. The exchange of experiences between participants outside the official room. The new businesses that emerge and the ideas that emerge in this unpretentious prose.

It is true that we often traveled and held face-to-face meetings when in fact they were not essential. This is gonna change. We will be more effective from now on. We will learn to live with that. But, traveling on business is also a bit of leisure, as long as it's not overkill.

I BET A BET

I will make a risky bet: it is unquestionable that we will evolve a lot in connections and in new virtual businesses. The famous digitization will be inexorable. On the other hand, as soon as we feel safe we will take a leap back into relationships and physical connections. Perhaps we will be even more intense than before and additionally aided by the democratization of virtual connections.

As a friend told me: physical affections, when they become possible again, will become more intense because we will know what it is like to live without them and the lack they made us in this period of imposing and necessary distance.

The human being is not superficial. It cannot be superficial. Even fights and arguments are boring when they are virtual. And grace is exactly what makes us real humans.

To the next.

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Agriculture revolutions: from nomadism to Smart Farm

Several studies have shown that agriculture probably emerged in the transition from Paleolithic to Neolithic, around 9.000 to 10.000 thousand years ago in the region where today is the Middle East, part of which was formerly called the Fertile Crescent. This term is explained, because in the past the lands of this region were fertile for agriculture and on a map, it has the shape of a crescent moon. It is possible that in other regions of the planet, a similar process has also occurred.

From the moment that man intuitively realized that he could harvest seeds from the best plants, save them and sow them in the next harvest, he began to start a loving relationship between human beings and agriculture.

Then, he started to settle in certain places that had better conditions for survival, carrying with him seeds, seedlings and animals in the beginning of its domestication. This process led man to organize himself into society, starting to establish social, political, storage and exchange of goods, reflecting on the evolution of civilizations over time. Thus, the seed and man have always gone hand in hand, being the seed, since the beginning of agriculture, that diffused technologies and improvements for civilizations.

The industrial revolution, which had its heyday in Europe between the middle of the 18th century and the middle of the 19th, brought, among other benefits, scale production, internal combustion engines, electric energy and steel. The technological advances resulting from it have also allowed large-scale industrial production of food and textile products from agriculture, making it possible to produce large quantities of food and fibers as well as to export surpluses to other countries, reducing poverty and hunger in a world that already surpassed half a billion inhabitants.

In the post-World War II decades, the world experienced periods of food and resource shortages and rampant inflation. This fact demonstrates once again that agriculture has always accompanied humanity, whether in good times or bad. And it is this that in the following decades will allow significant population growth and an improvement in the quality of life.

The Green Revolution emerged in the 1960s, which consisted of the creation of improved varieties of cereals and the mass adoption of superior seeds as well as fertilization and mechanization as a widespread practice in crops. Its exponent was the North American Geneticist Normal Borlaug (1914-2009), who created dwarf wheat varieties capable of responding to nitrogen fertilization without yielding, resulting in great yield, a method also extended to rice and corn, which made it possible to reduce hunger in many African and Asian countries. This fact gave Borlaug the Nobel Peace Prize in 1970.

The green revolution promoted a significant increase in the yield of the main crops of cereals and oilseeds in the most different countries, producing surpluses for storage and export, significantly increasing the food supply at a global level.

The biotechnological revolution arrived at the commercial level in the late 90s with Soja RR, bringing together a range of environmental, technological and socio-economic controversies. The not-so-young reader should remember that there was still no legal release in Brazil for the technology, which caused many producers to illegally bring seeds of the "Maradona" soy from Argentina. The technology was finally released commercially in 2003 by CTNBIO, which was followed by several other releases such as soybeans, corn, cotton, eucalyptus, sugar cane and beans, with the majority of approved cultivars belonging to soybean, corn and cotton. In 2020, after 24 years of transgenic crops in the world, no impacts inherent to the use of this technology were observed.

The fourth revolution or agriculture 4.0 refers to the set of digital technologies integrated and connected through sensors, applications, drones, networks and systems that aim to provide subsidies for decision making in agribusiness. The numerous tools made available promise to reduce production costs, optimize processes, improve information acquisition and security in data monitoring and analysis.

Agriculture 4.0 also employs high performance computational methods, sensor networks, artificial intelligence, connectivity between mobile devices, cloud computing, analytical methods and solutions to process large volumes of data and build systems to support management and management decision making. It encompasses both agriculture and precision livestock, automation and agricultural robotics, in addition to Big Data techniques and the Internet of Things. In the 4.0 era, Smart Farm emerges, which literally consists of the smart farm and includes the use of numerous digital tools to assist in the monitoring of agricultural management and management processes.

Over the last 10,000 years, the fantastic evolution of agriculture has been noticed. The revolutions and the surprising scientific and technological development of agriculture have allowed to reach fantastic levels of productivity, contrary to the Malthusian Theory.

In all moments of humanity, it has always been present and has been decisive for overcoming crises and improving the quality of life. In the 21st century, the challenges for the sector will be increasingly greater, but fortunately Brazil can count on dedicated farmers and research that has made innovations available to producers. Agriculture has been changing, improved processes, developed new tools, and will act strongly to rebuild Brazil and feed the world.

REVOLUTION	PERIOD	DESCRIPTION
Agricultural	9000-10000 b.C.	Nomadism, beginning of crops and creations
Industrial	XVIII and XIX	Scale production, internal combustion engine, steel, electricity, factories
Green	60's	Promotion of the use of better inputs
Biotechnological	90's-2000s	Adoption of transgenic varieties
Agriculture 4.0	2010 -	Promotion of digital tools

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Genomic editing in addressing the main challenges in health and agriculture

Genetics and health experts have endorsed genome editing as one of the most transformative technologies of the 21st century, with enormous potential to provide solutions to complex challenges in health and agriculture.

Genome editing provides advanced biotechnological techniques that allow precise and efficient targeted modification of an organism's genome. This technology presents the scientific community with tools at a relatively low cost for innovation in medicine, agriculture, the environment and industrial biotechnology. Progressive technology also has an immense potential to contribute to the construction of a sustainable bioeconomy.

Source: ISAAA

The top 5 cultures biotechnology occupies 99% of the global biotechnological cultures

In 2018, a total of 70 countries adopted biotech crops - 26 countries cultivating and 44 countries importing. Of the 31 crops approved for food, feed and release into the environment registered in the ISAAA GM Approval Database, 13 crops were planted in 26 countries in 2018, five of which occupy 99% of the global biotech crop area, in more than 1 million hectares.

Firstly, GM soy, grown on 95.9 million hectares in 9 countries, the United States and Brazil being the largest producers and exporters, followed by Argentina, Paraguay, Canada, Uruguay, Bolivia, South Africa and Chile , and approved for import into 18 countries. 38 culture events were approved in 31 countries, and of the total cultivated area, 78% is GM.

GM corn was grown on 58.9 million hectares in 14 countries and approved for import in 15. 137 different crop events were approved in 35 countries. Of the total corn grown, 30% is GM.

Source: ISAAA

Promising plant viruses to treat diabetes and arthritis

An Italian research team investigated the design and synthesis of plant virus nanoparticles with peptides associated with diabetes and rheumatoid arthritis. Its goal is to design nanoparticles and discover therapeutic benefits for both autoimmune diseases.

The scientific team is led by the University of Verona with the help of the John Innes Center, which has developed constructions of the cowpea mosaic virus to fight diabetes. The peptides were also inserted into the peptide sequence of the tomato weight deficit virus to obtain the chimeric particles and use it against rheumatoid arthritis. Plant viruses are known to have self-assembling nanostructures with versatile and genetically programmable envelopes. Their virus nanoparticles (VNPs) can be programmed to incorporate sequences for specific functions.

Scientists were able to observe that VNPs have the potential to modulate the immune system's response. Using animal models to test responses, they found that the peptide-related mechanism in which VNPs act as scaffolding and adjuvant has an overlapping mechanism of action, supporting the idea that recombinant nanoparticles can prevent diabetes and improve arthritis.

Source: Science Advances and John Innes Center

CRISPR-Cas9 used to transform corn traditional waxy version

Waxy maize is a specialized maize that produces starch with high levels of amylopectin that has special values from food or industry. To guarantee the reproductive efficiency of normal to waxy corn, the CRISPR-Cas9 system was used, involving the desired target mutation of the Wx locus at the bottom ZC01 (ZC01-DTMwx). The researchers applied the triple selection to the segregants to obtain high recovery of the bottom of the genome with wx mutations without transgene. A total of 6 mutants were obtained between the progeny crossed with ZC01-DTMwx. Mutant strains exhibited higher levels of amylopectin in endosperm starch compared to wild-type controls

Source: The Crop Journal