Protection of Cultivars in the Inter-University Network for the Development of the Sugar-Energy Sector

Márcia Brito Nery ALVES
Graduate Program in Intellectual Property Science – PPGPI
Federal University of Sergipe – UFS – São Cristóvão/SE – Brazil
marcia.bna@gmail.com

Ana Eleonora Almeida PAIXÃO
Graduate Program in Intellectual Property Science – PPGPI
Federal University of Sergipe – UFS – São Cristóvão/SE – Brazil
aepaixão@gmail.com

Abstract

This article aims to analyze the intellectual property in Brazilian agriculture, taking as reference the protection of sugarcane cultivars of the Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA). At first, a review of the literature was carried out with the objective of situating the problem of the protection and registration of cultivars, especially in the Brazilian case, as well as the procedures and stages of mapping and technological prospection of cultivars. Using a descriptive and exploratory methodology, guided by the multiple case study, information was systematized regarding the data obtained in documentary analysis and technological prospection that allowed the construction of a characterization of each of the ten federal universities participating in the network: Federal University of Alagoas (UFAL), Federal Rural University of Pernambuco (UFRPE), Federal University (UFG), Federal University of Viçosa (UFV), Federal University of Sergipe (UFMT), Federal University of Mato Grosso (UFMT), Federal University of Goiás , Federal University of Paraná (UFPR) and Federal University of Piauí (UFPI). The results allowed to visualize the objective conditions of research of the Network, performing a mapping of the cultivars registered by each one of the institutions, in the last 15 years, and that, therefore, they are still legally protected. Although the results presented by RIDESA reflect the state of the Network as a whole, it was considered that the need for more in-depth analyzes on the inequality of conditions and resources, as well as resources and technical capacity, which could possibly have a direct influence on the results in terms of intellectual property, observed for each of the institutions that make up the Network.

Keywords: Intellectual property, Cultivars, Technological prospecting, RIDESA

1. Introduction

Brazil is responsible for more than 50% of the sugar marketed worldwide, being the world's largest sugar and ethanol producer of sugarcane, followed by India and China. (SOUZA, 2015). The introduction of this

crop in Brazil dates back to the colonial period, with records of the arrival of the first seedlings still in the first decades of colonization of the territory.

It is assumed that sugarcane was introduced in America between the years 1493 and 1496. According to Figueiredo *et al* (2010), the first sugarcane seedlings were planted on Madeira Island, present-day Dominican Republic, on the occasion of the second voyage of the Christopher Columbus fleet. In Brazil, sugarcane began to be planted in the first decades of its colonization, around 1532, constituting the seeds, of stems originating from the Island of Madeira. At the beginning of its plantation, the cultivation of the Crioula variety predominated absolutely on the whole planted area, being replaced two centuries later by the species S. Officinarum (LANDELL, BRESSIANI, 2010).

Sugarcane is distinguished by its great range of varieties, performance and productivity. Belonging to the Poaceae family, which designate from the botanist's point of view, angiosperms of the Liliopsida class and subclass Commelinidae, sugarcane is characterized by its high adaptability to tropical and subtropical climates. Among the species belonging to the genus Saccharum, originating in tropical regions, such as the southern portion of Asia and islands of Melanesia, are mainly produced alcohol and sugar. From the crossing of species of the genus Saccharum, such as S. Officinarum and S. Spontaneum, new species emerged as S. Sinense and S. Barberi. (NÓBREGA; DORNELAS, 2006)

When exploring the dimensions of registration and protection of sugarcane cultivars in the Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA), this text sought to hold a debate on the importance of the genetic improvement program conducted by RIDESA, in the development, registration and protection of new varieties of sugarcane. In order to do so, a reflection was made on the importance of technological prospecting as a mechanism for systematizing information of social and economic relevance, drawing a framework that permeates the legal grounds of registration and protection of new varieties, until the presentation of the results of the research, especially, a characterization of the federal universities that make up RIDESA, its role in the Network and available research structure, as well as the cultivars legally protected by each of these institutions.

2. Literature review

2.1 Protection and registration of cultivars in Brazil

Article 3, section IV, of the Law of Protection of Cultivar n.9456 (BRASIL, 1997), defines the meaning of cultivar, as a variety of any genus or superior plant species, lays the legal bases for the consolidation of the mechanisms of registration and protection of property rights over cultivars. From the quantitative point of view, one can even correlate the number of cultivars of a particular plant species, the potential of agricultural advances and business evolution in the agricultural field, as well as in sugarcane (NOBREGA; DORNELAS, 2006 , p.15)

The National System of Protection of Cultivars (SNPC) and National Register of Cultivars (RNC), managed by the Ministry of Agriculture, Livestock and Supply (MAPA), were created after a long debate and frustrated attempts that began in the 1940s. (SILVA *et al.* 2013). The National Register of Cultivars (RNC) was instituted on December 30, 1997, through decree n.527, of the MAPA, with the purpose of

promoting the organization, systematization and control of both production and commercialization of seedlings and seeds. The purpose of the Register is to enable companies in the agricultural sector, related to the production and commercialization of seedlings and seeds, to have their cultivars released, be they forest species, forage plants, fruit trees, ornamental trees, among others.

According to Silva (2012), the National Register of Cultivars establishes the criteria that fundamentally guarantee the technical and legal compliance of the product or service, and its quality. The RNC also established new rules for determining the value of a cultivar, defined as Value of Culture and Use (VCU). Thus, the evaluation of the value of cultive and use became a basic requirement for a cultivar to obtain the guarantee of its registration in the RNC, and can be commercialized thereafter (MARINHO *et al.*, 2011). The minimum requirements for the registration and marketing of a cultivar will necessarily take into account the results of the VCU evaluation trials.

The VCU, from a structural point of view, consists of a value resulting from the conjugate of the agronomic characters of the species (cultivar), with its various characteristics of use, be it in agricultural, commercial or industrial activities. The starting date of the first trials, as well as the place where the experiment will be installed, must be communicated in advance, aiming at the legally planned activities of supervision and inspection (SALINAS, BONACELLI, 2012).

In addition to the RNC, in order for the cultivar to have the intellectual rights of its breeders recognized by the Law of Protection of Cultivar, which allows, for example, the collection of royalties for its exploitation, it is necessary that the cultivar holds the Certificate of Protection of Cultivar, issued by the National System of Protection of Cultivars. The obtaining of the certificate and the legal prerogatives of the breeder, deriving from it, is a *sui generis* form of intellectual property, associated exclusively with the plant varieties.

Having as main characteristic its singularity and particularity, the Certificate of Protection of Cultivar differs, for example, from patents, for which attributes such as innovation, industrial application, inventive activity and descriptive sufficiency are required, specific requirements such as novelty, distinguishability, homogeneity, stability and proper designation. (BRASIL, 2011)

It is important to emphasize that only the protection of the cultivar does not give right to the commercialization of its seeds or seedlings, and it must be properly registered in the RNC. Therefore, as we have seen, it is necessary to have proven the merit, which is based on the establishment of minimum requirements, revealed through the test of Value of Culture and Use (VCU). It is also important to observe certain characteristics of the National Register of Cultivars, which, for example, prevent the same cultivar has more than one inscription, as well as determine that the cultivar is associated with at least one maintainer, and may be natural or legal person, considered the legal guardian, to maintain a minimum stock of propagation material of the cultivar, looking out for its varietal purity and genetic identity (SALINAS; BONACELLI, 2012).

When noting that the protection of cultivars is not the same as their registration in the RNC, despite the fact that the two processes are carried out under MAPA, a clear distinction can be made between the objectives, legal bases, technical instruments and purposes of the mechanisms of protection of cultivars and of cultivars registration, as shown in Table 01:

Table 01 - Main differences between protection and registration of cultivars in Brazil

	Cultivar Protection	**Cultivar Record**
Objective	Ensure industrial property rights for the breeders. One can have the protection of a cultivar, without its commercialization being allowed.	It allows cultivars to be produced and marketed in Brazil. One can have registered cultivars that are produced and marketed without payment of royalties, for non-protection or being in the public domain.
Legal Basis	Law n.9.456/1997 - Law of Protection of Cultivars	Law n.10.711/2003 - Seed Law
Technical Instrument	Distinguishability, Homogeneity and Stability (DUS)	Value of Culture and Use (VCU)
Finality	Assure the rights of exclusivity of its holder regarding the use of these. The holder may license, collect royalties, assign and prevent third parties from using it without their authorization.	Creation of an agronomic information bank, providing data to the public authority regarding the origin of the material and its responsible in Brazil.

Source: Adapted from Bruch (2012)

2.2 Mapping and technological prospection of cultivars

Prospecting studies, in general, are based on the investigation, study or analysis of what should happen, as well as on the inquiry, probing or examining what we would like to happen (MAYERHOFF *et al*., 2008). For this same reason, one of the main objectives of the survey is to delineate and test possible and desired visions; and not to unravel the future (AMPARO; RIBEIRO; GUARIEIRO, 2012). Therefore, prospecting has as its main focus, to act in the moment of choices, that is, in making decisions that will contribute to an increasingly clear definition of the future.

In this context, technological prospecting can be considered as a tool to guide research, development and innovation (PD & I) efforts (BIAGGI, 2017, p.17). For this author, the technological prospection can be dated from the 50's and aimed to reduce the time between the invention and the provision of new products on the market. From a methodological point of view, the technological prospection process can be systematized into four phases (Table 02):

Table 02 - Phases of the technology prospecting process

Phase 01	The objectives, scope, approach and methodology to be used for the exercise of exploration.
Phase 02	Pre-prospective, where the detail of the methodology is focused;
Phase 03	Prospective, dedicated to data collection, processing and analysis;
Phase 04	Post-prospective, where the results are communicated, the implementation of the actions and their monitoring.

Source: Adapted from Bahruth (2004)

Through technological prospecting it is possible to systematically analyze the current and past information necessary for the design of future scenarios, in terms, for example, of establishing a priority agenda for R&D investments. Technological prospecting in this context should be able to promote a process of awareness of intellectual property rights, leading to a progressive improvement of the competitiveness mechanisms involving products, processes and services (LOPES, SANTOS, COSTA, 2017, p.592).

The mechanisms and processes of technological prospection, when oriented to systematize information from agricultural research, tend to construct scenarios of total societal interest, based on structured knowledge bases to support strategic decision making. Legal mechanisms for registering and protecting the rights of breeders, such as the Law of Protection of Cultivars (LPC), ensure and promote scientific and technological progress in this area.

According to Almeida (2008), as a consequence of the Law of Protection of Cultivars, the organization of agricultural research in Brazil, in terms of coordination and management, gained a new impulse, mainly characterized by the introduction of protection mechanisms associated with intellectual property law. From the institutional point of view and related to the public research, it can be affirmed that the Law of Protection of Cultivars was a dividing line in the creation and consolidation of the conditions necessary to the organization of strategic partnerships involving seed companies, organizations of research and development and companies producing agrochemicals.

It is not by chance that the success of sugarcane cultivation is attributed, for example, to the use of cultivars, obtained through genetic improvement. The progress made by public and private research institutions in their experimental stations is an unquestionable reality (SOUZA, 2015). The studies of technological prospection reveal the panorama and the complexity of these processes, as well as their present and future social and economic relevance.

3. Results and discussions

3.1 RIDESA and the genetic improvement of Sugarcane in Brazil

The Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA) was created after the extinction of National Program for the Improvement of Sugarcane (Planalsucar), in the 1990s. Nowadays, RIDESA is composed of 10 federal institutions: Federal University of Alagoas (UFAL), Federal Rural University of Pernambuco (UFRPE), Federal University (UFG), Federal University of Viçosa (UFV), Federal University of Sergipe (UFMT), Federal University of Mato Grosso (UFMT), Federal University of Goiás, Federal University of Paraná (UFPR) and Federal University of Piauí (UFPI). The research aimed to characterize the 10 universities that make up RIDESA in terms of intellectual property, especially regarding their contributions in the development, registration and protection of sugarcane cultivars. The mapping and technological prospecting are presented as necessary procedures to survey the current and future situation of RIDESA in terms of their performance as a whole and the role of each institution linked to the Network.

In this sense, documentary surveys were carried out in the development plans of the federal universities involved, information available in the catalogs launched by RIDESA, and through consultation of the

CultivarWeb Database of the Ministry of Agriculture, Livestock and Supply. Through the consultation, it was possible to identify 205 records of sugarcane cultivars, of which 68 are cultivars of the Republic of Brazil, represented by the prefix RB, developed by RIDESA. With regard to the total number of protected cultivars, out of a total of 123 records of protected sugarcane cultivars, 30 cultivars are RB, that is, approximately 24% of the cultivars observed.

3.2 Registration and Protection of Cultivars

Methodologically, the study collected data from the National Plant Protection System (SNPC) and the National Register of Cultivars (RNC), referring to cultivars of varieties of scientific names Saccharum L. and Saccharum officinarum L. The data collected were organized according to the institutions that hold the rights of protection or maintainers of the records.

In Brazil, the National Register of Cultivars (RNC), governed by Law No. 10.711 (BRASIL, 2003), regulated by Decree No. 5.153, 2004, performs a prior authorization of cultivars and species for which the holder of the registration (natural or legal persons) can start the production and commercialization of seeds and seedlings. Table 03 shows a current table of the sugarcane cultivar record in Brazil, based on data from the RNC.

Table 03 - Number of registered sugarcane cultivars in Brazil

REGISTRATION HOLDER	**N.º**
RIDESA	68
COPERSUCAR	37
CTC - CENTRO DE TECNOLOGIA CANAVIEIRA S/A	34
INSTITUTO AGRONÔMICO - IAC	28
MONSANTO DO BRASIL LTDA.	22
BIOVERTIS PRODUÇÃO AGRÍCOLA LTDA	9
SYNGENTA PROTEÇÃO DE CULTIVOS LTDA	2
NOT SPECIFIED	2
AGROPAV AGROPECUÁRIA LTDA.	1
INSTITUTO CENTRO DE ENSINO TECNOLÓGICO - CENTEC	1
USINA DA BARRA S/A AÇÚCAR E ÁLCOOL	1
Total	**137**

Source: Prepared by the author, 2019

Table 03 allows to consider the current relevance of RIDESA, first in the ranking of the 10 institutions that maintain register of cultivars of sugarcane in Brazil. On the other hand, with regard to cultivar protection, data from SNPC placed RIDESA in second position in the ranking of the 11 institutions that own intellectual property rights on sugarcane cultivars, as can be seen in Table 04.

Table 04 - Number of protected cultivars of sugarcane in Brazil

PROTECTION HOLDER	**N.º**
CTC - CENTRO DE TECNOLOGIA CANAVIEIRA S/A	33
RIDESA	30
INSTITUTO AGRONÔMICO - IAC	18
MONSANTO DO BRASIL LTDA.	12
BIOVERTIS PRODUÇÃO AGRÍCOLA LTDA	9
CARAMURU ALIMENTOS S.A.	8
UNIVERSIDADE FEDERAL DE SANTA MARIA-UFSM	5
VIGNIS S/A	4
SYNGENTA PROTEÇÃO DE CULTIVOS LTDA	2
COSAN S/A INDUSTRIA E COMERCIO	1
VOTORANTIM CIMENTOS N/NE S.A.	1
Total Geral	**123**

Source: Prepared by the author, 2019.

The Law of Protection of cultivars (LPC), sanctioned in April 1997, provides for the granting of intellectual property title on cultivars obtained through plant breeding. In the specific case of research on genetic improvement of sugarcane, a series of agronomic and technological characteristics are considered so that a variety can be protected. In a recent study of technological prospecting carried out on RIDESA sugarcane cultivars, 94 characteristics were considered (SILVA et al, 2013). Table 05 summarizes the main agronomic and technological characteristics present in RB cultivars, in terms of percentage.

Table 05 - Main agronomic and technological characteristics of RB cultivars

CHARACTERISTIC	**%**	**CHARACTERISTIC**	**%**
High agricultural productivity	44	Fits well with reduced spacing	3
High sucrose content	33	High precocity	3
Excellent sanity	22	High agroindustrial productivity	3
Good sprouting in seedbeds	15	High sucrose richness	3
Excellent sprouting in cane-plant	15	Good sprout shoots in favorable environments	3
Excellent sprout growth	14	Good load density	3
Precocity	8	Good behavior in floodplains	3
Good sprouting in sugarcane	6	Difficult flowering	3
Medium sucrose content	6	High regrowth capacity	3
Rapid vegetative growth	6	High sanity	3
Wide adaptability	5	High ATR	3
Good sanity	5	Excellent performance on sandy soils	3
Great sprout budding	5	Excellent agricultural production in cane plant and sprout	3

Long PUI	5	Blossoming rare	3
Wealth	5	Precocious maturation	3
High longevity of sugarcane	4	Average agricultural productivity	3
Great tillering	4	Upright	3
Drought Tolerance	4	Rusticity	3

Source: Adapted from Silva *et al* (2013)

It is possible to notice that the two main agronomic and technological characteristics of RB cultivars are "High agricultural productivity" and "High sucrose content", respectively present in 44% and 33% of the cultivars analyzed. The authors (*Ibid*., 2013) also analyzed agronomic and technological characteristics less evident in RIDESA cultivars, among which the following stand out: High regrowth capacity; High agricultural productivity in the plant budding and rebudding; High productivity in all types of soil; High industrial productivity; High resistance to drought; High tillering in cane-plant and budding; High yield manual cutting; High fiber content; High fiber content at the beginning of the harvest; Absence of flowering; Good adaptation to mechanized harvesting; Good adaptation to low fertility soils; Good adaptation to light soils of medium fertility; Good sprout and crop yield; Good longevity of the sugarcane; Good resistance to drought; Good response to fertigation; Good behavior like sugarcane; Good performance in machined cutting; and, Good closing in between.

Also considered were: Good agroindustrial potential when allocated in indicated production environment; Good manual cutting performance; Good sucrose content at the end of the harvest; Standing reeds of excellent harvestability; Mechanical harvesting; Dense peaks; High load density; High sugar content in the middle and at the end of harvest; Stability; Excellent sprout, budding under mechanized harvesting; Excellent harvestability; Excellent behavior in mechanized harvesting; Excellent development; Excellent response to ripeners; Fast germination; Excellent interior; Longevity of rag; Material of good harvestability; Rustic material; Late mean maturation; Very rich in medium harvest for late harvest; Very productive; Very responsive in favorable environments; It does not flourish and does not pucker; Great racer; Great interlocking closure; Rapid recovery to hybrid stress (dry); Fast closing; Recommended planting in soils in the Cerrado; Resistant to scalding of leaves; Resistant to rust; resistant to coal; Resistant to mosaic; Resistant to red streaks; Responds well to ripeners; Responsive to maturer and can be cut at the beginning of harvest.

3.3 Characterization of Institutions participating in RIDESA

Notwithstanding the notable differences between participating institutions, especially in relation to research infrastructure, fundraising capacity and qualified personnel involved, the collaborative methodology adopted by RIDESA allows the knowledge to be shared unrestricted among its members, especially through the exchange of promising RB clones that are evaluated in experiments on the Network as a whole.

Each of the federal institutions linked to RIDESA develops its own Genetic Improvement Program for Sugarcane (PMGCA), with the collection of the Sugarcane Germplasm Bank of the Flowering and Crossing Station of the Serra do Ouro, in the municipality of Murici, state of Alagoas. RB cultivars developed by

RIDESA are duly registered with the Germplasm Committee of the International Society of Sugar Cane Technologists (ISSCT).

3.3.1 Federal University of São Carlos - UFSCar

The Federal University of São Carlos - UFSCar, offers 62 undergraduate and 73 postgraduate courses (47 masters and 26 doctorates). In 1991, the creation of the Araras campus allowed UFSCar to incorporate the units of the National Program for the Improvement of Sugarcane (PLANALSUCAR), located in São Paulo. Two years later, in 1993, with the creation of the Agrarian Sciences Center (CCA), the activities of the Agronomic Engineering course were started (Figure 01).

Figure 01 - Sugarcane Improvement Program (PMGCA-UFSCar)

Source: Digital Repository of PMGCA-UFSCar. Available in: <https://ridesaufscar.com.br>

Currently, the Sugarcane Improvement Program (PMGCA) of UFSCar is linked to the Department of Biotechnology, Plant and Animal Production (DBPVA). RIDESA/UFSCar is headquartered in Araras/São Paulo and its area of activity covers the states of São Paulo and Mato Grosso do Sul, totaling 5,000 ha, with 170 industrial plants and associations. RIDESA/UFSCar has 10 protected cultivars, according to table 06.

Table 06 - Protected Cultivars/UFSCar

CULTIVAR	INITIATION OF PROTECTION	TERMINATION OF PROTECTION
RB925211	10/12/2007	10/12/2022
RB925268	10/12/2007	10/12/2022
RB925345	10/12/2007	10/12/2022
RB935744	10/12/2007	10/12/2022
RB965902	23/11/2011	23/11/2026
RB965917	23/11/2011	23/11/2026
RB975201	16/03/2017	16/03/2032
RB975242	16/03/2017	16/03/2032
RB975952	16/03/2017	16/03/2032
RB985476	16/03/2017	16/03/2032

Source: Prepared by the author, 2019

3.3.2 Federal University of Alagoas - UFAL

Federal University of Alagoas (UFAL) is a federal institution of higher education with headquarters in Maceió and two campuses in the interior of the State: Campus Arapiraca and Campus do Sertão, in the city of Delmiro Gouveia. UFAL, as a whole, offers 84 undergraduate courses, 30 master's degrees and 9 doctorates. Since 1990, the Center for Agricultural Sciences (CECA) has developed the Genetic Improvement Program for Sugarcane (PMGCA) in partnership with industry companies, industrial plants and associations (Figure 02).

Figure 02 - Sugarcane Genetic Improvement Program (PMGCA-UFAL)

Source: Digital Repository of Tribuna Hoje. Available in: <https://www.tribunahoje.com>

The PMGCA/UFAL has the mission of managing the Sugarcane Germplasm Bank in the Serra do Ouro, located in the municipality of Murici. The maintenance and control of access to the Germoplasm Bank's collection has allowed new technological developments and innovations for the sugarcane sector, making possible the development of new cultivars through the universities connected to the Network.

RIDESA/UFAL is headquartered in Maceió/Alagoas and its area covers the states of Alagoas, Maranhão and Bahia, totaling 430,000 ha, as well as its units: 17 industrial plants and associations. RIDESA/UFAL has 7 protected cultivars, according to table 07.

Table 07 - Protected Cultivars / UFAL

CULTIVAR	INITIATION OF PROTECTION	TERMINATION OF PROTECTION
RB931003	27/12/2011	23/12/2026
RB931011	30/08/2011	30/08/2026
RB951541	30/08/2011	07/02/2026
RB961552	09/05/2017	09/05/2032
RB98710	27/12/2011	23/12/2026
RB991536	09/05/2017	09/05/2032
RB99395	30/08/2011	30/08/2026

Source: Prepared by the author, 2019

3.3.3 Federal University of Paraná - UFPR

The Federal University of Paraná - UFPR, offers 130 undergraduate courses, 76 master's degree courses and 49 doctorates. The Agrarian Sciences Sector has five undergraduate and five Stricto Sensu post-graduate programs, master's and doctoral degrees (Figure 03). The Agronomy Course was created in 1915 and is linked to the Department of Phytotechnology and Phytosanitaryism.

Figure 03 - Sector of Agricultural Sciences - UFPR

Source: Digital Repository of UFPR. Available in: <https://www.ufpr.br>

The Sugarcane Genetic Improvement Program of the Federal University of Paraná (PMGCA) has been linked to the Department of Phytotechnology and Phytosanitarism since 1991, working in the development of research, teaching and extension activities with sugarcane.

RIDESA/UFPR is headquartered in Curitiba/Paraná and its area of operation covers the state of Paraná, Santa Catarina and Rio Grande do Sul, totaling 520,000 ha, with 20 industrial plants and associations. RIDESA/UFPR has six protected cultivars, according to table 08.

Table 08 - Protected Cultivars / UFPR

CULTIVAR	INITIATION OF PROTECTION	TERMINATION OF PROTECTION
RB036066	03/03/2017	03/03/2032
RB036088	03/03/2017	03/03/2032
RB036091	03/03/2017	03/03/2032
RB946903	23/02/2010	23/02/2025
RB956911	23/02/2010	23/02/2025
RB966928	23/02/2010	23/02/2025

Source: Prepared by the author, 2019

3.3.4 Federal Rural University of Pernambuco - UFRPE

The Federal Rural University of Pernambuco (UFRPE) offers 54 undergraduate courses and 48 postgraduate programs. It has three academic units, in the municipalities of Cabo de Santo Agostinho,

Garanhuns and Serra Talhada, and six advanced campuses, among which the Carpina Sugarcane Experiment Station (EECAC) stands out (Figure 04).

Figure 04 - Carpina Sugarcane Experiment Station (EECAC-UFRPE)

Source: Digital Repository of UFRPE. Available in: <http://prppg.ufrpe.br/eecac>

At EECAC, which covers an area of 261 hectares, the research activities of the Genetic Improvement Program for Sugarcane - PMGCA are conducted. Being the largest research program among the UFRPE units, EECAC is responsible for the Flowering Station and Crossing of Devaneio, located in the municipality of Primavera. At the site, the hybridization campaigns and special studies of RIDESA are carried out annually.

RIDESA/UFRPE is based in Carpina/Pernambuco and its area of activity covers the states of Pernambuco, Paraíba and Rio Grande do Norte, totaling 255,000 ha, as well as its units: 22 industrial plants and associations. RIDESA/UFRPE has 4 protected cultivars, according to table 09.

Table 09 - Protected Cultivars / UFRPE

CULTIVAR	INITIATION OF PROTECTION	TERMINATION OF PROTECTION
RB002504	19/06/2012	19/06/2027
RB002754	04/04/2017	04/04/2032
RB962962	19/06/2012	19/06/2027
RB992506	04/04/2017	04/04/2032

Source: Prepared by the author, 2019

3.3.5 Federal University of Viçosa - UFV

The Federal University of Viçosa (UFV) has 67 undergraduate courses distributed in its three campuses: Florestal, Rio Paranaíba and Viçosa. The UFV offers 44 postgraduate programs, of which 24 are stricto sensu programs, at master's and doctoral level. The area of Agrarian Sciences is the most developed in the UFV, being well known both in Brazil and abroad.

Since 1993, the Plant Engineering Department coordinate the Sugarcane Improvement Program (PMGCA), and inherited the technical and patrimonial assets of the extinct PLANALSUCAR. The development of research on genetic improvement of sugarcane is carried out at the Center for Research and Improvement of Sugarcane-CECA in the city of Oratórios where the stages of the sugarcane selection process are annually carried out, beginning of sowing in the month of July (Figure 05).

Figure 05 - Center for Research and Improvement of Sugarcane (CECA-UFV)
Source: Digital Repository of PMGCA-UFV. Available in: <https://www.canaufv.com.br>

RIDESA/UFV is headquartered in Viçosa/Minas Gerais and its area covers the state of Minas Gerais (870,000 ha), with 37 industrial plants and associations. RIDESA/UFV has three protected cultivars, according to table 10.

Table 10 - Protected Cultivars / UFV

CULTIVAR	INITIATION OF PROTECTION	TERMINATION OF PROTECTION
RB937570	09/06/2011	09/06/2026
RB987935	09/05/2017	09/05/2032
RB988082	09/05/2017	09/05/2032

Source: Prepared by the author, 2019

3.3.6 Federal University of Goiás - UFG

The Federal University of Goiás (UFG) offers 150 undergraduate courses, distributed in five units: Goiânia and Aparecida de Goiânia, Catalão, Jataí, Cidade de Goiás and Cidade Ocidental. The UFG has 78 Stricto Sensu postgraduate courses at the master's and doctoral levels. The Sugarcane Genetic Improvement Program (PMGCA) of UFG is developed in the Plant Breeding Sector of the School of Agronomy (Figure 06).

Figure 06 - Genetic Improvement Program for Sugarcane (PMGCA-UFG)

Source: Digital Repository of SOCICANA. Available in: <http://www.socicana.com.br>

RIDESA/UFG is headquartered in Goiânia/Goiás and its area of activity covers the state of Goiás (900,000 ha), as well as its units: 23 industrial plants and associations. RIDESA/UFG does not have protected cultivars.

3.3.7 Federal Rural University of Rio de Janeiro - UFRRJ

The Federal Rural University of Rio de Janeiro (UFRRJ) offers 56 undergraduate courses, 41 of which are offered at Campus Seropédica, 11 at Campus Nova Iguaçu and 04 at Campus Três Rios. UFRRJ has 48 Stricto Sensu postgraduate courses, of which 34 are masters and 14 are PhDs.

The Sugarcane Genetic Improvement Program (PMGCA), UFRRJ, is developed at Campos dos Goytacazes Campus (Figure 07), located in the Northern region of the State, as well as at the Espírito Santo Regional Station in the municipality of Conceição da Barra, State of Espírito Santo.

Figure 07 - Campos dos Goytacazes Campus (UFRRJ)

Source: Digital Repository of UFRRJ. Available in: <https://portal.ufrrj.br>

RIDESA / UFRRJ is headquartered in Campos dos Goytacazes/Rio de Janeiro and its area of operations covers the states of Rio de Janeiro and Espírito Santo, totaling 117,000 ha, as well as its units: 11 industrial plants and associations. RIDESA/UFRRJ does not have protected cultivars of sugarcane.

3.3.8 Federal University of Sergipe - UFS

The Sugarcane Genetic Improvement Program (PMGCA), UFS, is developed on the campus of São Cristóvão, in the city of São Cristóvão and in the Rural Campus of the Federal University of Sergipe, under the responsibility of the Center for Applied Agrarian Sciences (CCAA). The CCAA has the function of providing support for practical teaching, research and extension activities both for the institution's undergraduate courses and for postgraduate courses in the area of Agrarian Sciences and related fields (Figure 08).

Figure 08 - Applied Agricultural Sciences Center (CCAA-UFS)

Source: Digital Repository of UFS. Available in: <http://ufs.br>

The CCAA was established through Resolution 56/2014 of the University Superior Council. The Center establishes itself as a laboratory for field classes in several practical disciplines. It is therefore an experimental area for teachers and students to carry out research and extension activities, such as field days and lectures. RIDESA/UFS is headquartered in Nossa Senhora da Glória/Sergipe and there are no listed units in its area of operation, as well as no protected cultivars.

3.3.9 Federal University of Mato Grosso - UFMT

Federal University of Mato Grosso (UFMT) has five campuses: Cuiabá, Rondonópolis, Sinop, Araguaia and Várzea Grande. UFMT has 101 undergraduate and 56 postgraduate courses at Masters and PhD levels. UFMT joined the group of institutions linked to RIDESA in 2010. The Sugarcane Genetic Improvement Program (PMGCA) of the Institution is linked to the Department of Phytotechnology and Phytosanitary of the Faculty of Agronomy, Veterinary Medicine and Zootechnics – FAMEVZ (Figure 09).

Figure 09 - Genetic Improvement Program for Sugarcane (PMGCA-UFMT)

Source: Digital Repository of SOCICANA. Available in: <http://www.socicana.com.br>

RIDESA / UFMT is headquartered in Cuiabá/Mato Grosso and its area of activity covers the state of Mato Grosso (230,000 ha), with 170 industrial plants and associations. RIDESA/UFMT does not have protected cultivars.

3.3.10 Federal University of Piauí - UFPI

The Federal University of Piauí (UFPI) offers 107 undergraduate courses and 42 post-graduate programs stricto sensu, 35 of which are at the master's level and 07 at the doctoral level. The Sugarcane Genetic Improvement Program of the UFPI (PMGCA / UFPI) is located in the Plant Science Department of the Agricultural Sciences Center, in an area of approximately 2.5 hectares (Figure 10).

Figure 10 - Center of Agrarian Sciences (UFPI)

Source: Digital Repository of UFPI. Available in: <https://www.ufpi.br>

The area destined to PMGCA, of the UFPI, adds the necessary physical structure for the production of sugarcane seedlings in the initial phase of the program. The PMGCA has an experimental station in the area of the Comvap industrial Plant, which is located in the municipality of União. At the experimental station the selections of new sugarcane genotypes for the productive sector are carried out. RIDESA/UFPI is headquartered in Teresina/Piauí and its area of activity covers the state of Piauí, totaling 15,344 ha, having an industrial plant agreed. RIDESA / UFPI does not have protected cultivars.

3. Conclusions

When analyzing the role of the Inter-University Network for the Development of the Brazilian Sugar-Energy Sector (RIDESA), with respect to its role in the development, registration and protection of cultivars, one can perceive its strategic importance in terms of network of public institutions, guaranteeing the registration of more than 33% of the cultivars developed and registered in the country, and currently owns the intellectual property rights of approximately 24% of legally protected cultivars, out of a total of 123 records in the RNC.

However, when observing each of the 10 institutions that make up RIDESA, there are great differences in terms of infrastructure and human and financial resources that reflect in the development of new sugarcane cultivars and consequently in the number of requests protection of developed varieties. It was observed that the institution with the highest number of legally protected varieties is UFSCar, presenting a number of 10 cultivars. Then the UFAL, with 7 cultivars; UFPR, with 6; UFRPE, with 4; and the UFV, with 3 cultivars. The others, UFG, UFRRJ, UFS, UFMT and UFPI do not present results in terms of registration of protected cultivars.

It can be affirmed that RIDESA is one of the most successful research and development networks, at national level, regarding the development, registration and protection of new cultivars, despite the occasional differences related to the specificities of each one of the universities the network. While networking favors information sharing and an acceleration in the production of new knowledge, it is a fact that the discrepancy related to the notable differences between the associated institutions imposes a limit on the progress and evolution of RIDESA.

Finally, this analysis allowed assessing, on the one hand, the strategic importance of RIDESA in the scope of the Brazilian sugar-energy sector, and on the other hand, the challenges of structuring the Network that may result not only in increasing levels of performance in global terms, but also so that each institution can be able to contribute effectively to its presence in the Network.

It is considered that more in-depth studies will shed light on the strengths and weaknesses of the network, as well as the threats and opportunities, both internal and external, in order to build a general framework of the conditions necessary for RIDESA as a whole, as well as each of the ten federal universities participating in the Network can grow in a uniform way, reducing the mismatch observed in terms of intellectual property.

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