Intellectual Property in the Brazilian Agricultural Sector: A Case Study of the Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA)

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Abstract

Intellectual property is a legal device that guarantees the individual or legal entity the protection of their creations, be they products or processes, covering copyright, industrial property and sui generis protection, modality in which the plant variety property rights are included. In this sense, this paper analyzes the intellectual property rights in the Brazilian agricultural sector, through a case study of the Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA), by raising data related to research, development and protection of sugarcane cultivars, designated by the prefix Republic of Brazil (RB). In order to do so, a brief historiography of the evolution of legislation on the subject, the conditions and consequences of Brazil's adherence to international agreements such as "Trade Related Aspects of Intellectual Property Rights" (TRIPS) and the convention of "International Union for the Protection of New Varieties of Plants" (UPOV), as well as, a survey about the emergence and role of RIDESA as a collaborative innovation network was also carried out. As a result, it was possible to conclude that the issue of intellectual property rights on cultivars is multidimensional and suggest the need for creation of functional and consolidated models of knowledge management in collaborative innovation network. Among the elements and factors constituting the crisis in the Brazilian sugar-energy sector, mainly on the basis of the varietal census for the states of the northeast region (especially the state of Alagoas), it was possible to point the importance of RIDESA in the context of overcoming crisis of the sugar-energy sector through innovation.

Keywords: Intellectual Property; National Service of Protection of Cultivars (SNPC); TRIPS; UPOV; RIDESA.

1. Introduction

The Inter-University Network for the Development of the Sugar-Energy Sector (RIDESA) is formed by 10 Brazilian federal universities: Federal University of Alagoas (UFAL); Federal Rural University of Pernambuco (UFRPE); Federal Rural University of Rio de Janeiro (UFRRJ); Federal University of Sergipe (UFS); Federal University of Mato Grosso (UFMT); Federal University of Goiás (UFG); Federal University of São Carlos (UFSCar); Federal University of Viçosa (UFV); Federal University of Paraná (UFPR); and Federal University of Piauí (UFPI). The Network focuses in the technological development of sugarcane, especially in the new varieties research, with 79 research bases, and more than 300 partner private companies, producing ethanol, sugar and energy. Currently, the varieties launched by RIDESA correspond to more than 60% of the sugarcane planted in Brazil. One of the main differentials of RIDESA is related to its presence in all sugarcane producing states. This presence occurs through partner universities that maintain research centers in all producing regions.

Based on a theoretical configuration focused on intellectual property and collaborative innovation, this paper analyzes the performance of RIDESA as a function of the collaborative environment and partnerships, which, in the last decades, have been implementing new levels of innovation capacity and levels of organization in network. The results obtained translates into increased competitiveness, knowledge management, new skills, greater efficiency and better control of costs for the sector, uncovering from the academic point of view, a fertile field for the production of knowledge.

The state of Alagoas is a special Brazilian state for RIDESA, being considered the starting point of the Sugarcane Genetic Improvement Program, since it has a germplasm bank with more than 2000 genotypes. UFAL is the direct responsible for the maintenance of this bank, from which, a great exchange of genetic material is established for the research and exchange of experiences between the researchers and other partners, being therefore a very important node of sustentation of the topology and functioning of the network as a whole. The program has had a direct impact not only on the development of new sugarcane cultivars, but also on the production of knowledge, with a large number of master's dissertations and doctoral theses completed and in progress, as well as patent registrations .

UFAL, as seen, besides being an indispensable partner of RIDESA, has sought to develop actions through its Nucleus of Technological Innovation (NIT) based on innovation in all segments of science and technology, having as a legal basis for its operation, federal laws like the law n. 9.279, of May 15, 1996 (rights and obligations related to Industrial Property); law n. 9,609, of February 19, 1998 (protection of Intellectual Property of computer program and its commercialization); law n. 8,974, of January 5, 1995 (use of genetic engineering techniques and releases into the environment of genetically modified organisms); law n. 9,456, of April 28, 1997 (protection of cultivars) and other similar legislation and its updates.

In recent years, several patents have been awarded to researchers in the state of Alagoas, which is a consistent proof of the importance of the research work that being done. In this context, the following patents registered in the National Institute of Intellectual Property (INPI) are highlighted: PI-0306525-1 (System for the production of ethanol with microorganisms immobilized in sugarcane stalks and process for immobilization of micro-organism in sugarcane stalks); PI-0306524-3 (Configuration of fermenters in

series for the production of ethanol with immobilizers microorganisms in corn cob); and, PI-9300474-5 (Process for the production of ethanol with microorganisms immobilized in sugarcane stalks; a system for producing ethanol; a process for the immobilization of microorganisms in sugarcane stalks; and, a process for the immobilization of microorganisms in sugarcane stalks).

Finally, the academic and socioeconomic relevance of this research is related to the role and importance of the sugar-energy sector for the development of the country as a whole and the need to establish the intellectual property issue in terms of strategic value and as part of a good collaborative innovation process in which RIDESA is a notorious case and, therefore, the *locus* par excellence of this research.

2. Literature Review

2.1 Intellectual Property in the Brazilian Agricultural Sector

The issue of intellectual property rights in the Brazilian agricultural sector involves a systematic and comprehensive conceptual framework of the main factors that go back to the organization of the agricultural research since the 1970s, investments in research and development in the sector, the current state of technical knowledge and technological aspects, as well as the research infrastructure, taken as fundamental variables to the establishment of the initial conditions for innovation.

With the rapid advancement of biotechnology and advances in plant breeding, the protection of intellectual property rights in the agricultural sector has become a determining factor for the success of Brazilian agriculture. In this context, since its establishment in 1992, the National Agricultural Research System (SNPA) has played a key role both in the public sector and in the private sector, supporting decisively the innovation systems in the sector.

The presence of the public sector in genetic improvement, whether through the Brazilian Agricultural Research Corporation (EMBRAPA) and other state agricultural research organizations, or through universities and research institutes, was fundamental for the definition of guidelines and strategies for development of agricultural research in the country, within a strategic vision, guided by actions and goals that would culminate, at present, with what is observed in terms of development of the agricultural sector and national agribusiness.

In a historical context, the Law of Protection of Cultivars (LPC), the "Trade Related Aspects of Intellectual Property Rights" (TRIPS) and the adhesion of Brazil to the convention of the "International Union for the Protection of New Varieties of Plants" (UPOV) are presented as strategic frameworks for the articulation between intellectual property in the Brazilian agricultural sector and national technological development. The characteristics of the Brazilian genetic heritage and the strategic importance of developments in the biotechnology sector are equally determinant, especially when analyzed in light of the Biosafety Law.

From a conceptual point of view, the need for a reflection on the role of the National Plant Protection Service (SNPC), especially in view of the specificity of the *sui generis* protection of plant varieties, taking into account the particularities of obtaining plant variety property rights, especially in what distinguishes

in relation to patents, leading to a necessary analysis of the current state of the debate about the constitution of the right of royalties on cultivars, for example.

2.2 The Public Sector and the Agricultural Research in Brazil

In view of the progress in research and development (R&D) in the national agricultural sector since the 1970s, mainly related to the genetic improvement of plants, it became fundamental that the country ensure intellectual property rights related to the development of new cultivars. Freitas (2006), in this sense, considers the differences in R&D among "developed nations", where new developments in the sector are in the hands of private institutions, in relation to Brazil, where, according to the author, appear to focus on public institutions. The author concludes by stating that one of the reasons for this phenomenon results from the difficulty of the State to ensure the rights provided in the legislation to the breeders of the new cultivars (Vieira Filho, Vieira, 2013).

Carvalho (2003) analyzes the cultivars protection in Brazil through the incorporation of protected cultivars in the seed market, the institutional dimension of legislation management, as well as research and development in plant breeding, emphasizing the relevant role of intellectual property on innovation systems dynamics in agriculture. It also analyzes EMBRAPA and other institutions with which it has a partnership, in order to understand the broader scenario of its role through the SNPA for the development of the agricultural productive sector.

The author warns of the need for capacity building of institutions that deal with plant breeding, regarding the issue of legal protection of intellectual property. One of the hypotheses defended is that "mechanisms for the protection of intellectual property are fundamental for the organization and coordination of agricultural research and can strengthen the institutionality of public research" (*ibid*., P.2). The author also analyzes the EMBRAPA, in the process of innovation in the agricultural sector, through the systematization of agricultural research, as well as the recognition of the strategic importance of intellectual property rights. Carvalho; Salles-Filho; Paulino (2007, p. 24) point out that "the institutional articulation promoted by EMBRAPA, organizing partnerships aimed at the development of new proprietary varieties […] are examples of how it is possible to treat intellectual property as an element of interaction".

The relevant role played by the public sector over the last decades, whether through partnerships aimed at consolidating innovation systems in the agricultural sector or through adherence to international agreements such as TRIPS, justifies too much the success of Brazilian agriculture. The author, in this sense, presents a relevant data when affirming that "the public sector of plants improvement has more than 80% of the activities related to improvement of plants, and more than 90% of the qualified personnel working in public research institutions" (Freitas, 2006, p.42).

Intellectual property plays an important role in defense of prerogatives of rights holders on new cultivars, representing an important stimulus to innovation in the agricultural sector, be it in the genetic improvement of plants or in the development of transgenic plants. In this context, Yamamura (2006) analyzes the regulatory frameworks related to the research, development, production and trade of transgenic plants, at a national and international scale, correlating them to the policies of incentive to innovation in the Brazilian agricultural sector, with a view to better exploitation of local potentialities.

At the national level, the author emphasizes the importance of the Industrial Property Law, the Cultivars Protection Law, the Biosafety Law, as well as the Provisional Measure on Access to Brazilian Genetic Heritage, lamenting that "lack of internal consensus can lose the accumulated experience in genetic improvement; leads to loss the opportunity that the country has to increase its activities through modern biotechnology and to get a slice greater than 1%, which is the current value, in international trade "(*ibid*., p.108).

In analyzing the contemporary trends related to intellectual property in agriculture, Carvalho (2003, p.17) concludes that "the strategic management of intellectual property assets and the intellectual property as an incentive for innovation and complementarity between fields of rights protection, are of particular relevance". In addition, Carvalho; Salles-Filho; Paulino (2006, p.337) adds that "intellectual property enables a process of coordination between agents that are articulated to use fragmented knowledge and owned by various economic agents." In general, many authors defend the public sector, emphasizing its historical importance in the consolidation of innovation systems in agriculture that allowed great advances in terms of both agricultural research and economic development in Brazil.

2.3 Intellectual Property in Agriculture

The national legislation on intellectual property has undergone numerous transformations since 1991, still under the government of Fernando Collor de Mello. One of these changes is directly associated with Brazil's accession to the UPOV convention. According to Bassi (2012, p.13), “despite having a long history of granting intellectual property rights [...] Brazil had not yet provided any form of crop protection until the mid-1990s, with the option of joining UPOV”, as a consequence of the approval of the 1997 Cultivars Law.

The 1996 Patents Act (succeeded by the 1997 Cultivars Act) was a decisive step in the broad spectrum of changes in intellectual property rights that would take place since the 1990s. The peculiar characteristics of the variety of plants grouped under the *sui generis* label, was accepted by TRIPS as a model capable of meeting the specificities of the cultivars protection.

In this sense, Bassi (*ibid*., P.11) reaffirms that "with regard to the *sui generis* protection of plant varieties, it is generally stated that the model offered by UPOV is a suitable form of protection to comply with the requirements of TRIPS." Regarding UPOV's positioning in relation to the *sui generis* system, Yamamura (2006, p.104) emphasizes that the organization is struggling to become "officially recognized as the promoter of the *sui generis* system of protection referred to in the TRIPS text "(Yamamura, 2006, p.104).

The UPOV system admits two versions that are in force at the same time, one from 1978 and another from 1991. Francisco (2009) performs a comparative analysis of the regulatory system versions and alerts that both are in force concurrently in countries with different commercial interests, possibly in contrast. This situation has been analyzed and debated by the TRIPS Council. In both UPOV system versions, the author highlights critical elements related to legal aspects related to the obligation of remuneration due to the use of transgenic cultivars, both nationally and internationally, seeking to understand transparency in the rules on the formation of obligations, royalties, and damages.

The existing conflicts arising from the application of both UPOV regulations simultaneously to groups of signatory countries with such diverse socio-economic and technological development characteristics need a definitive solution, and this condition will only be possible to the extent that legal contrasting aspects to be pacified by mutual agreement. Among the many conflicts that can be verified, Carvalho; Salles-Filho; Paulino (2007, p.13) highlights one of the problem situations in the UPOV texts. According to the authors, "the 1978 UPOV Review there was an indication that protected varieties should be distinct, homogeneous and stable, with the exception of the farmer and the breeder." While "the 1991 UPOV Review had added the requirement for the variety to be new".

In view of the possible legal problems that the present situation of UPOV regulations suggests, Francisco (*Ibid*., 282) warns that the coexistence of two current texts, with divergent points of view on critical points of cultivars protection, implies that the same facts or legal acts can have different classifications for the member countries of the treaty, depending on the text of UPOV to which this country is bound, "constitutes a serious problem for international relations, especially among member countries".

2.4 The strategic dimension of cultivar protection

The modernization of the economy is strongly based on new knowledge related to the emergence of the intellectual property system and constitutes the background of an essential debate for the development of the biotechnology innovation systems, in Brazil, suggesting the need of a conceptual analysis and more in-depth legislation on the subject (Vieira et al, 2010). The case of the cultivar protection legislation, understood as *sui generis* intellectual property, is an example that indicates the need for a deeper analysis of interpretative misunderstandings, given the possible economic consequences.

The dichotomous condition that places, on the one hand, the regulation of intellectual property as a more comprehensive legal system, and, on the other, legislation that aims to meet the specificities of the protection of plant varieties, constitutes a striking feature of the search for a technical definition, but also legal aspects of the particular characteristics of plant variety property rights, in relation to the legal mechanisms for the intellectual property rights, as a whole. According to Vieira et al (*Ibid*., P. 344), a circumstantial issue is to have a clear definition of whether it is a patent or a cultivar. According to the authors "there is a common area in the regulation of intellectual property. [...] However, Brazil opted for the *sui generis* legislation for the protection of cultivars, as a basis for the regulation of plant biotechnology.

Based on SNPC data, Carvalho; Salles-Filho; Paulino (2007) point out that the protection of plant varieties and the recognition of the rights of breeders are part of a strategy based on the articulation between intellectual property and national technological development. The authors argue that the reorganization of public research related to the development of new cultivars is a process that reinforces public presence and its importance in the seed market, for example. With respect to the fact that the new cultivars receive *sui generis* protection, the authors explain that "plant varieties or cultivars protection differ from patents, for example, both by the scope and by the exceptions or limitations imposed on the holder of rights. It is, therefore, considered a *sui generis* protection. (*Ibid*., P.325)

For Mascarenhas (2004), although the biotechnology sector is considered strategic for the country, the low technological and economic capacity to use the available natural resources in a sustainable way is

a fact that affects not only Brazil, conforming in one of the great challenges to be faced by economically poor countries (Mascarenhas, 2004). According to Padilha (2012, p. 169), "[...] The search for a balance between the international protection of intellectual property rights and the effects of intellectual property rights in competition law are related not only to legal and economic arguments. In fact, according to the authors, a range of "social issues, which become important and necessary, is opened for both analysis and assumptions about the existence of interfaces.

Vieira Filho; Vieira (2013) carried out a mapping of the evolution of cultivars protection records after the implementation of the Cultivars Protection Law, based on data from the National System of Protection of Cultivars of the Ministry of Agriculture and Livestock (SNPC/MAPA). The authors note that the number of protected cultivars is increasing at an accelerated rate, while the profile of the companies that hold plant variety rights has been defined in an environment that ranges from public institutions to private companies, both domestic and foreign. They also noted that between 1998 and 2012, the number of protected cultivars in Brazil rose from 51 to 1,780, a jump of approximately 35 times. The authors exemplify that "only in the soybean market, on the one hand, in 1998, were 39 protected cultivars. On the other, in 2012, they added to these more than 500 cultivars, totaling 539 "(*Ibid*., P.25). The authors also highlight the case of Embrapa, which in 2012 had 30% of soybean cultivars, or 158 cultivars, of which 39 were transgenic.

Finally, it can be seen that the issue of intellectual property rights on cultivars is multidimensional and can be analyzed from several points of view. In this paper, we highlight the case of RIDESA, a network of 10 Brazilian public universities, as it is a network that holds the intellectual property rights of more than 60% of all sugarcane varieties currently cultivated in Brazil. The emergence and the role of RIDESA in the research and development of new cultivars shows the importance of the formation of collaborative innovation networks to strengthen the Brazilian sugar-energy sector.

3. Results and Discussions

3.1 The Role of Collaborative Innovation Networks in the Brazilian Sugar-Energy Sector

The need for innovation in the Brazilian agricultural sector, especially in the sugar-energy sector, is the search for alternatives to increase productivity in the agricultural field. In this sense, the importance of collaborative innovation networks, in the development and commercialization of new cultivars, becomes a point of convergence for strategic actions aimed at the promotion of intellectual property in agriculture. RIDESA, understood as a collaborative innovation network is situated in a context in which innovation and technological development alternatives are the main determinants of productivity growth, bypassing the historical determinants, for which the increase in production is directly linked to the increase in planted area.

According to Vidal; Santos; Santos (2006, p.16), the cost of sugar production in Brazil is the lowest in the world, at around US $ 180 / ton in the Center-South and US $ 210.00 in the North-Northeast. According to the authors, these data shows that the sugar-energy sector in the north and northeast of Brazil has competitiveness in the external market, with production costs slightly higher than those obtained in the

south-central part of the country. However, the specificity of soil and climatic conditions, especially low soil fertility, the reduced average volume of rainfall associated with the irregularity of the topography, considered inadequate for mechanization in many regions, lead to extra costs of production in the northeastern sugarcane crop. [...] The largest sugarcane producers in the Northeast are the states of Alagoas and Pernambuco (figure 1), and the expansion of the sugarcane frontier in the Northeast should focus on Maranhão, Piauí and in the valleys of the semi-arid region. (*Ibid*., P. 7-8).

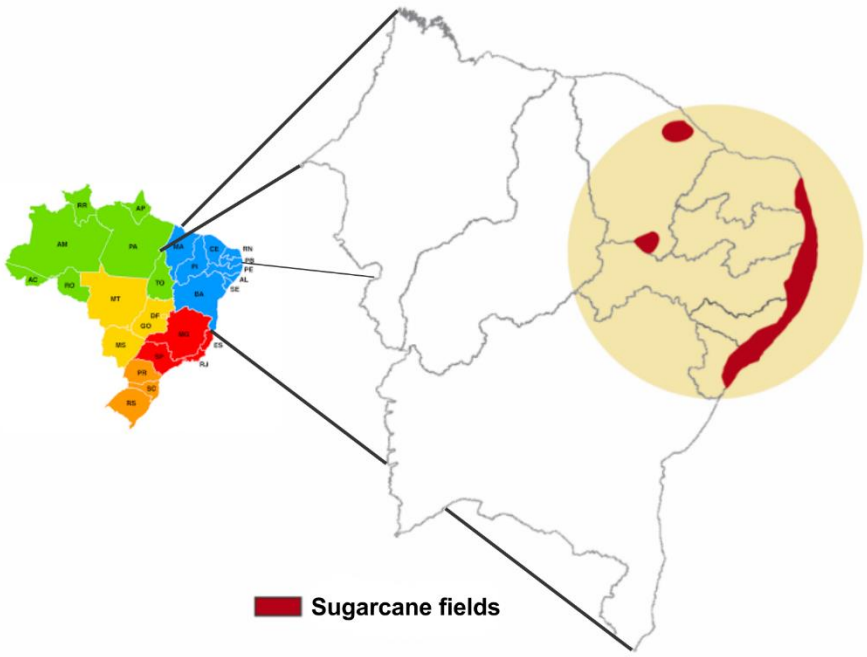

Figure 1. Sugarcane in Northeast Brazil region

Source: Prepared by the author (2018)

According to Pegorin; Andrade (2011), the increase in ethanol production in the last ten years in Brazil was due to a large investment in research and technological development, but also to a strengthening of the innovation networks of the sugarcane industry and environmental governance of the sector. It is considered that there is a technological platform in the sugar-energy sector that favors the consolidation of bioethanol in the domestic market. But the expansion of bioethanol in the foreign market and the increased market for co-products derived from sugarcane depends on the commercial scale deployment of second generation technologies. (*Ibid*., P.28)

For Fronzaglia and Martins (2010), there are three coordinated ways in structuring the research and development of technological innovations in the sugar-energy sector: 1. Public research organizations; 2. Research corporations; 3. Networks. In Brazil, the role of innovation networks in the sugar-energy sector is essential to the technological development of the sector. RIDESA was created, in this sense, with the intention of continuing the development of research in the context of the Sugarcane Genetic Improvement Program (PMGCA). In the last 20 years, 65 RB cultivars were launched, according to the table 1.

Table 1. Cultivars released by RIDESA

Launch Year	***Institution holding the intellectual right***	***Cultivars***		
1977	PLANALSUCAR	RB70141*	RB70194*	RB7096
1981	PLANALSUCAR	RB705007	RB705051	RB705146
1982	PLANALSUCAR	RB725147*	RB725828*	RB735275*
		RB72454*		
1985	PLANALSUCAR	RB732577	RB754665	
1986	PLANALSUCAR	RB721012*		
		RB705440	RB739359*	RB739735*
1988	PLANALSUCAR	RB765418*	RB785148*	RB735220*
1992	UFSCar	RB785750*	RB806043*	RB825336*
		RB835089*	RB835486*	
1993	UFAL	RB75126*	RB83102*	RB83160*
		RB83252	RB83594*	
1995	UFSCar	RB835019	RB855156*	RB855453*
		RB855563		
1996	UFRPE	RB763710	RB813804	
1998	UFSCar	RB835054*	RB845257*	RB855035*
		RB855113*	RB855536*	RB855546
	UFV	RB867515*		
1999	UFRRJ	RB758540*		
2000	UFAL	RB8495	RB842021	RB855511*
		RB855463*		
2001	UFPR	RB845197*	RB845210*	RB855036*
		RB865230*		
2002	UFV	RB928064*		
2003	UFRRJ	RB858927*		
	UFAL	RB92579*	RB93509	RB931530
2005	UFRPE	RB863129	RB872552	RB932520
		RB943365	RB943538	
2006	UFSCar	RB925211	RB925268	RB925345
		RB935744		
2010	UFAL	RB931003	RB98710	
		RB931011	RB99395	
		RB951541		
2010	UFPR	RB946903	RB956911	
		RB966928		

2010	UFRPE	RB962962	RB002504
2010	UFSCar	RB965902	RB965917
2010	UFV	RB937570	

* Cultivars that have had or have commercial cultivation.

Source: Adapted from http://www.ridesa.agro.ufg.br/p/3723-technology

3.2 Sugarcane Varietal Census in the State of Alagoas (2016/17)

Currently, the varieties of acronym Republic of Brazil (RB) are being cultivated in more than 65% of the area with sugarcane in the country, that is, a contribution of around 12.3% in the Brazilian energy matrix (RIDESA, 2018). In the state of Alagoas, the RB varieties are cultivated in at least 68% of the planted area. According to the National Supply Company of the Southeast Region, it continues to be the largest national producer, accounting for 73% of the sugar produced in the country, followed by the Central-West Region (11%), the Northeast Region (8.2%) and South (7.7%). São Paulo, Minas Gerais, Paraná, Goiás and Alagoas remained the largest sugar producers (CONAB, 2018). In Figures 2 and 3 below, it can be observed the 10 most cultivated varieties and the 10 most planted varieties, respectively, in the state of Alagoas, in the 2016/17 crop.

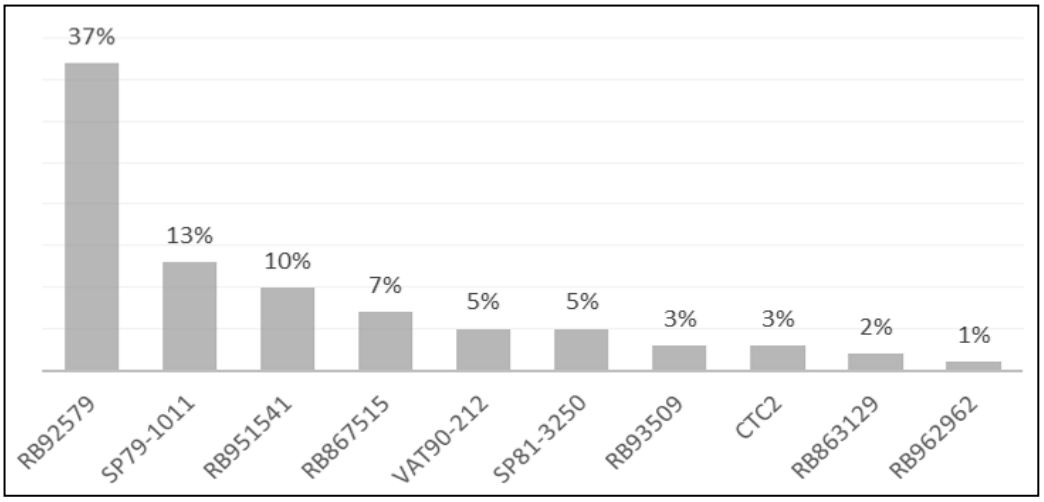

Figure 02 - 10 Cultivars most cultivated in the state of Alagoas - 2016/17 crop.

Source: Data from the National Supply Company (CONAB), 2018.

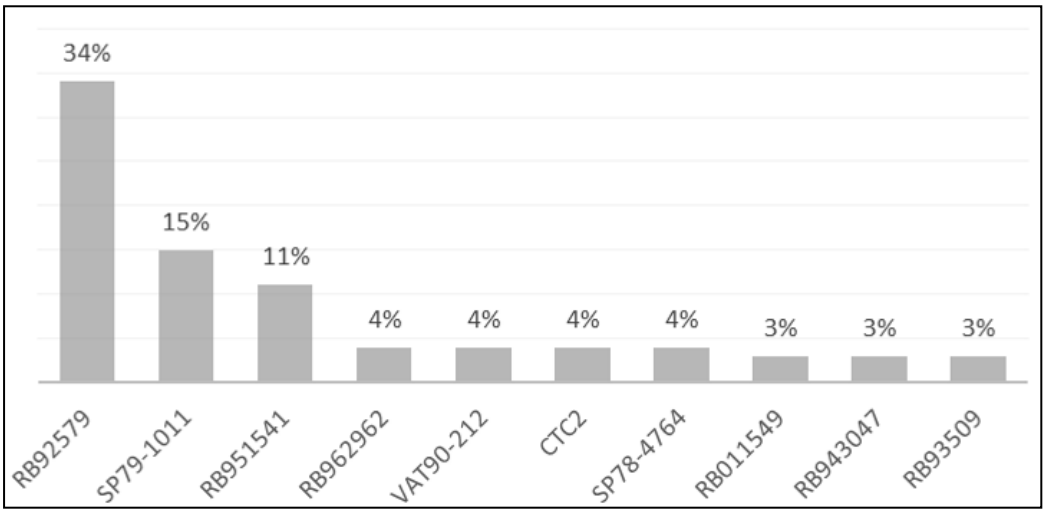

Figure 03 - 10 Most planted crops in the state of Alagoas - 2016/17 crop.
Source: Data from the National Supply Company (CONAB), 2018.

In Figures 2 and 3 it can be seen the importance of RIDESA in the development of cultivars, especially in the launching of variety with the characteristics necessary for its development in different regions. It can be noted that cultivar RB92579 is both the most cultivated and the most planted variety, surpassing at least twice the cultivation area of the variety SP79-1011. In Figure 4, it can be observed the distribution of the most planted and cultivated varieties in the state of Alagoas, with absolute prominence for the RB varieties.

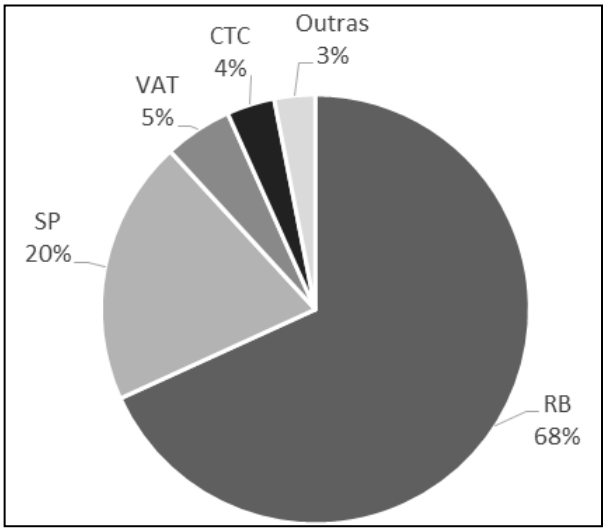

Figure 4 - Most cultivated varieties in the state of Alagoas2016/2017 crop
Source: Data from the National Supply Company (CONAB), 2018.

It is known that the increase in productivity is largely due to the development of new cultivars, which directly implies the importance of programs such as those proposed and developed by RIDESA. In

this sense, it can be concluded that during the development of new varieties, advances in agronomic research, involving the emergence of new techniques and technologies associated with soil management, production of high quality seedlings, new planting techniques and cultural management, new developments and new perspectives related to the legal guarantees of cultivar protection have projected new socioeconomic development horizons, in the state of Alagoas and in Brazil as a whole.

4. Conclusion

Intellectual Property is a legal device, linked to innovation, fundamental for the technological and economic progress of organizations. Federal universities, whether through individual research activities of teachers or through existing research groups, have been taking increasingly significant steps in the consolidation of knowledge management models and practices aimed at the development of intellectual property. The consolidation of interuniversity research through collaborative innovation networks is a decisive and strategic step towards technological development guided by the strengthening of intellectual property

With regard to *sui generis* protection, it was observed that the creation and consolidation of collaborative innovation networks, like RIDESA, constitutes a decisive step related to the advances in agronomic research, leading to the emergence of new techniques and technologies associated with soil management, production of high quality seedlings, new planting techniques and cultural management, projecting new frontiers and perspectives related to the legal guarantees of cultivars protection.

In Brazil, since federal law n. 10,973 of 2004, federal universities have created nuclei of technological innovation (NIT's) as well as nuclei of intellectual property (NPI's) aiming at the development of models and practices of innovation that produce concrete results in terms of indicators of Intellectual Property. Although these nuclei are consolidating recently, institutions still lack knowledge management models, especially to work in networks or to create the conditions for existing research groups to articulate themselves in interuniversity networks, such as RIDESA, in a process that leads to the emergence of new collaborative innovation networks in all areas of scientific research.

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