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EFFICIENCY OF THE PROCESS OF SOYBEAN SEED PRODUCTION IN PARAGUAY

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Abstract

The objective of this work was to evaluate the quality of the seeds produced in Caaguazú Department and to verify improvements in the production, packaging, storage and commercialization systems of the company. The work was carried out in the seed analysis laboratory of the company SEM-AGRO S.A.E., located in the district of Dr. Juan Eulogio Estigarribia, department of Caaguazú, Paraguay. The data were obtained through records implemented by the company's quality management system, which are performed in each company process, from the field to the commercialization. The percentage of planned and approved surface use for seeds is 64.7% in the harvests from 2010/11 to 2013/14. The average yield is 2,826 kg per hectare of seeds. The yield after conditioning is 1,870.5 kg per hectare of seeds, with 68% of use. The quality of the seed adds in the production of off-season in relation to the regular harvest. The sowing is concentrated in two cultivars and has less diversity of cultivars.

EFICIÊNCIA DO PROCESSO DE PRODUÇÃO DE SEMENTES DA SOJA NO PARAGUAI

Palavras-chave: *Glycine max (L.)*; produção de sementes; Paraguay.

Resumo

O objetivo deste trabalho foi o de avaliar a qualidade das sementes produzidas no estado de Caaguazú e verificar as melhorias nos sistemas de produção, embalagem, armazenamento e comercialização da empresa. O trabalho foi realizado no laboratório de análise de sementes da empresa SEM-AGRO S.A., localizada no distrito do Dr. Juan Eulogio Estigarribia, estado de Caaguazú, no Paraguai. Os dados foram obtidos através de registros implementados pelo sistema de gestão da qualidade da empresa, que são realizados em cada processo da empresa, desde o campo até a comercialização. O percentual de uso da superfície planejada e aprovada para sementes foi de 64,7% nas safras de 2010/11 a 2013/14. O rendimento médio foi de 2.826 kg por hectare de sementes. O rendimento após o condicionamento foi de 1.870 kg por hectare de sementes, com 68% de uso. A qualidade da semente agrega na produção de entressafra em relação à colheita regular. A semeadura está concentrada em duas cultivares e possui menor diversidade de cultivares.

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INTRODUCTION

The soybean (Glycine max (L.) Merril) belonging to the Fabaceae family is of great economic importance, Brazil is the main producer, followed by the United States, Argentina, China, India and Paraguay (CONAB, 2018). The fragmentation of Paraguayan soybean production is distributed in Alto Paraná (28%), Canindeyú (19%), Itapúa (18%) and Caaguazú (13%), corresponding to 78% of the sown area of the country (MAG, 2013). US Department of Agriculture (USDA), in its latest trade bulletin and agricultural markets, increased Paraguayan soy production by 800,000 tonnes for the 2017/18 crop, stipulating a total of 10 million tonnes. This volume represents a decrease of 2% compared to the 2016/17 harvest, when the harvest was a record, with 10.2 million tons. At the beginning of the season, local newsletters indicated that there could be declines in harvest volume because of the less favorable weather conditions. However, the development of the campaign passed in a positive way and almost reached the same levels of the previous crop.

The use of seeds of high qualitative value is essential for the expression of the productive potential of the species and the variety in cultivation. The reason for this is that the seed carries the advances of plant breeding, expressed by the genetic attribute, and its performance is influenced by physical, sanitary and physiological attributes (ROSSI et al., 2017).

This attribute is based on the comparison of the needs, expectations, pretensions or specifications previously established by regulations and the peculiar characteristics of the market (DGQ, 2007). Under these conditions the main techniques of seed analysis are demonstrated, these tools being useful for quality control and immediate, medium- and long-term decision making. In Paraguay, soybean in recent years shows a great dynamics of business efficiency resulting in investments in the infrastructure of silos and beneficiation machines, as well as the use of cultivars with high genetic potential destined to specific and recommended environments.

The determination of seed quality is attributed through four factors: genetic, physical, physiological and sanitary, these must be evaluated throughout the seed production and storage process. Genetic quality involves variety purity, grain quality and resistance to adverse conditions; in the physical characteristics, it is evaluated the physical purity, humidity, mechanical damages, thousand seed weight, appearance and weight of volumetric; the physiological attributes germination, seed dormancy and seed vigor, are determinants; regarding the health status of the seed, it is verified whether the seeds are free of pathogens (PESKE; BARROS; SCHUCH, 2012).

The parameters most used to evaluate seed quality are vigor and viability. The vigor is revealed when the conditions are favorable to the full development, this characteristic indicates a smaller growth of the plant due to the decline of biochemical functions, being inversely proportional to the process of deterioration (MARCOS FILHO, 2005). The deterioration reduces the quality, viability and vigor of the seeds due to the aging or effect of adverse environmental factors (SIADAT et al., 2012).

The germination test determines the viability, this parameter must express the maximum germinative capacity of the evaluated seed, determining the percentage of seeds that will produce normal seedlings, capable of germinating and emerging in favorable field conditions. In this way, the objective of this work was to evaluate the quality of the seeds produced in Caaguazú Department and to verify improvements in the production, packaging, storage and commercialization systems of the company.

MATERIAL AND METHODS

The work was carried out in the seed analysis laboratory of the company SEM-AGRO S.A.E., located in the district of Dr. Juan Eulogio Estigarribia, department of Caaguazú, Paraguay. The laboratory is certified according to the requirements of the ISTA (International Seed Testing Association) standards by SENAVE (National Secretariat of Vegetal Defense) dependent on MAG (Ministry of Agriculture and Livestock).

Figura 1. Map of the main departments of soybean producers in Paraguay.

The evaluations were carried out comparing the different batches of soybean seeds. These batches were bagged at a temperature of between 13°C and 16°C, cooling in maintenance silos, when this temperature was reached it passes through the cleaning equipment to the table separator, the standardizer and the bagging occurs at the humidity of 13%. The tank is maintained at a temperature of 25°C and the relative humidity of the air does not exceed 70%. The seed sampling method, for lots of more than 21,000 kg, corresponding to a primary sub-sample per 700 kg of seed, and this is subdivided to obtain one kilogram of seed to be sent to reception in the laboratory. Once the samples were received they were divided into the homogenizer until they had the weight of the laboratory samples, which are 500 grams.

Using the rules analysis of seed sampling, physical purity, germination analysis and thousand seed weight, according to the international rules of seeds, the quality tests were carried out.

In the germination test, four replicates of 100 pure seeds of each were used, using as substrate sterilized sand, polyethylene of 35 x 27 cm, plastic trays of 1 liter volume and the identification is written on a label, which mentions the number of tests, replicate number, planting date, dates of first and second germination counts.

For the tetrazolium test the collection of the samples in post-reception was sampled, 3 or 5 samples of each batch. Preconditioning is performed in the range of six hours at 41ºC, wet paper and two hours in solution at a concentration of 0.075% tetrazolium salt, determining two samples of 50 units of each seed, when it has a difference of 10% between the two samples the analysis repeats. The standard used in this analysis for the approval of seed lots was 60% vigor and 80% viability.

The data were obtained through records implemented by the company's quality management system, which are performed in each company process, from the field to the commercialization.

RESULTS AND DISCUSSION

Table 1 shows data on the planned and approved area of four harvests. In the four years losses were observed starting from the harvest, having plots affected by the drought. In 2012, seed production was affected as much as the normal harvest production (late sowing in October), from the late planting (December planting), reaching the use of 38% for the seeds that came for commercialization. In 2013, only 15.18% of the normal season and the whole of the off-season were used 60%. This is due to poor distribution of precipitation, lack of water in the seed filling stage, being greatly affected by changes in moisture, as a result of tetrazolium analysis revealed, there was a high percentages of moisture damage. It is worth mentioning that in the years of 2013 and 2014, 10% were not approved to have blends in flowering readings and were eliminated by legal procedures.

Table 1. Production area of planned and approved soybean seeds from four harvests of SEM-AGRO S.A.E.

Years	Approved Surface (ha)	Planned Surface (ha)	Performance (%)	Sowing time
2011	974	1393	69.92	Regular harvest
2012	500	1304	38.34	Regular harvest
2013	1100	1463	75.18	60% Off-season
2014	1185	1647	71.94	100% Off-season
Total	3759	5807	64.7	

In an overall average of 64.7%, the planned plots were used, without loss of quality due to excessive rainfall during harvesting, but due to water deficit and stinky bug damage. For the cases of plots lost by quality, they are explained by the lack of water at the time of formation and loaded with seeds, many of them lose quality due to water deficiency, have seeds with symptoms of water deficit and these are at the same time more susceptible to damages caused by environmental humidity.

It was observed in the Oceanic Niño Index (ONI), which is nothing more than the difference of the normal sea surface temperature in the Pacific Ocean, serving as a basis for the characterization of the El Niño and La Niña events. El Niño episodes are indicated by increases in sea surface temperature of more than 0.5 °C (0.9 °F) for at least five successive three-month overlapping seasons and, on the contrary, for La Niña. The 2010/11 and 2011/12 seasons were influenced by El Niño. Regarding the climate in Paraguay, generally, El Niño years give low quality of seeds, the neutral ones give good quality of seeds. This is observed in Table 2, due to the low efficiency of the planned and approved surface (38.34%) in the 2012 harvest.

Table 2. Data of the difference of the normal temperature (°C) from the surface of the sea in the Pacific Ocean.

Month/Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2010	1.6	1.3	1.0	0.6	0.1	-0.4	-0.9	-1.2	-1.4	-1.5	-1.5	-1.5
2011	-1.4	-1.2	-0.9	-0.6	-0.3	-0.2	-0.2	-0.4	-0.6	-0.8	-1.0	-1.0
2012	-0.9	-0.6	-0.5	-0.3	-0.2	0.0	0.1	0.4	0.5	0.6	0.2	-0.3
2013	-0.6	-0.6	-0.4	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.3	-0.4
2014	-0.6	-0.6	-0.5	-0.1	0.1	0.1	0.0	0.0	0.2	0.5	0.7	0.7

SOURCE: National Weather Service,2015.

As shown in Table 3, the greatest damage is due to moisture, reaching 61% moisture damage below vigor and 9% dead seeds in 2012. There are no records in 2011. Mechanical damages affect the quality on average of 3, 33% in the 6-8 bands, considered seed death, plus 3.66% moisture damage and 2% stinky bug damage, quality was affected by 8.99%.

Table 3. Tetrazolium tests per year and types of damage.

Years	Mechanical (%)		Moisture (%)		Stinky bug (%)		Vigor	Viability
(%)	1-8	6-8	1-8	6-8	1-8	6-8	(%)	(%)
2012	5	2	61	9	23	2	69	88
2013	11	4	57	1	22	2	83	93
2014	12	4	44	1	21	2	85	94
Average	9.33	3.33	54	3.66	22	2	79	91.66

Seed production is represented by income for the years 2011, 2012 and 2014 (table 4). The year 2013 was atypical for the yields obtained in the off-season period. In 2012 there was a drought in the region (Table 1), due to this, the moisture damage and vigor in the 2012 harvest was different from the others, reducing the germination and very strongly the vigor

Table 4. Productivity / gross yield and final product and disposal value due to processing in four seed harvests.

Years	Gross yield (kg/ha)	Seed yield (kg/ha)	Disposal by packaging (%)
2011	2595	1954	24.70
2012	2316	1140	50.77
2013	3688	2385	35.33
2014	2416	2003	17.00
Average			32

Table 6 shows a comparison of quality produced in the four years, evidencing an increase in the average of the germination of the lots, observing a 10% increase from 2011 to 2014, mainly due to the fact that there was a gradually increased production in times of off-season, reaching 100% of production in 2014. While it can also be observed that a less amount of seed is needed for sowing one hectare of soybeans, with a difference between 2011 and 2014 of 13.6% of less seed for sowing.

Table 5. Comparison of four years on the quality of soybean seeds produced and the effect on sowing.

Year	Germination (%) August	Germination (%) September	Hundred seed weight (gr)	NºPlant / meter	Nºseed / meter	Seed amount (kg/ha)	Nºof bags/ha
2011	83	83	14.3	16	19	67	1.7
2012	87	87	14.2	15.9	18	63	1.6
2013	90	91	14.8	15.3	17	62	1.5
2014	94	94	14.5	15.3	16	58	1.4

Each year the production is concentrated in two cultivars in volume and number of cultivars planted in the region. NIDERA A 5909 RG, with 72.7%, of the market share and 15.8% of IGRA 526, in 2014, while diversifying the number of varieties sown. This is because these cultivars have greater sowing amplitude in contrast to yield stability (Table 6). This reduction in the number of cultivars sown from 14 cultivars in 2011 to 7 cultivars in 2014 is by decision of the company to manage fewer varieties, to better manage its facilities, besides not being sure whether they will be sold or not. In figure 1, planting is progressing more and more, reaching in 2014 up to 30% of the seeds marketed in August. In the years 2011 to 2013, the sale occurs more in the month of October compared to 2014 in the months of August and September.

Table 6. Percentage of soybean cultivars sown from 2011 to 2014, as % of sales volume.

Cultivar	YEARS			
	2011 (%)	2012 (%)	2013 (%)	2014 (%)
NIDERA A 5909 RG	51	54	79	72.70
FTS CAMPO MOURAO RR	10	0	0	0
NA 66 RR	6	8	2	0
RA 626	6	2	1	0
V-MAX 7059 RR	6	5	0	0
IGRA 526	5	10	12	15.80
NIDERA A 4990 RG	4	3	0	0
A 6411 RG	4	3	0	0
CD 226 RR	2	0	0	0
CD 202 RR	2	0	0	0
CD 214 RR	1	0	0	0
NIDERA A 5009 RG	1	1	0	0
NIDERA A 5509 RG	1	0	0	0
NM 70 R	1	0	0	0
NS 6448	0	7	3	0
BMX POTENCIA RR	0	4	0	0
NS 4903	0	1	2	4.30
RM 5700	0	1	1	0
RMO 509	0	1	0	0
Don Mario 6.2i	0	0	0	3.70
SYN 9070	0	0	0	2.00
TMG 1264	0	0	0	1.30
CD 2585 RR	0	0	0	0.20
Cultivars	14	13	7	7

CONCLUSIONS

The percentage of planned and approved surface use for seeds is 64.7% in the harvests from 2010/11 to 2013/14.

The average yield is 2,826 kg per hectare of seeds.

The yield after conditioning is 1,870.5 kg per hectare of seeds, with 68% of use.

The quality of the seed adds in the production of off-season in relation to the regular harvest.

The sowing is concentrated in two cultivars and has less diversity of cultivars.

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