Revista Ciência Agronômica, v. 53, e20207128, 2022
Centro de Ciências Agrárias - Universidade Federal do Ceará, Fortaleza, CE
www.ccarevista.ufc.br

Scientific Article
ISSN 1806-6690

Provenance, viability and physical quality in seeds of *Panicum maximum* 'Mombasa'[1]

Procedência, viabilidade e qualidade física de sementes de *Panicum maximum* cv. Mombaça

José de Oliveira Cruz[2]*, Cibele Chalita Martins[3], Patricia Cândido da Cruz Silva[3], Renato Teó de Barros[3], Givanildo Zildo da Silva[4]

ABSTRACT - Identifying areas that would enable the production of highly pure and viable seeds is important for the logistics of companies that act in the seed sector. The aim of the present study was to evaluate the effect of provenance on the viability and physical quality of seeds of *Panicum maximum* 'Mombasa'. Nineteen seed batches from the states of São Paulo (six from Auriflama and three from Guzolândia) and Goiás (eight from Quirinópolis and two from Serranópolis) were evaluated using the following parameters: water content, viability by tetrazolium test, physical purity, PLS, 1000-seed weight and number of other seeds. Physical quality and viability in seeds of *P. maximum* 'Mombasa' are affected by their provenance. All the seed batches showed a sufficient level of viability to meet marketing standards. Based on physical purity, seed samples from Quirinópolis, Goiás should not be marketed. Based on an examination of noxious seeds, 85% of the seed samples are suitable for marketing.

Key words: Export. Mombasa Grass. Noxious seeds. PLS.

RESUMO - A identificação de áreas que possibilitam a produção de sementes com elevada pureza e viabilidade é importante para a logística das empresas do setor sementeiro. Nesse sentido, o objetivo desta pesquisa foi avaliar o efeito da procedência na viabilidade e na qualidade física de sementes de *Panicum maximum* cv. Mombaça. Dezenove lotes de sementes procedentes dos Estados de São Paulo (seis de Auriflama e três de Guzolândia) e Goiás (oito de Quirinópolis e dois de Serranópolis) foram avaliados por meio dos seguintes parâmetros: teor de água, viabilidade pelo teste de tetrazólio, pureza física, valor cultural, peso de mil sementes e outras sementes por número. A qualidade física e a viabilidade das sementes de *P. maximum* cv. Mombaça são influenciadas pela procedência. Todos os lotes apresentam sementes com viabilidade suficiente para atender aos padrões de comercialização. Com base na pureza física, o lote dois de Quirinópolis – GO não pode ser comercializado. Com base no exame de sementes nocivas 85% dos lotes podem ser comercializados.

Palavras-chave: Valor cultural. Exportação. Capim-mombaça. Semente nociva.

DOI: 10.5935/1806-6690.20220042
Editor-in-Chief: Alek Sandro Dutra - alekdutra@ufc.br
*Author for correspondence
Received for publication 21/01/2020; approved on 10/02/2022
[1]Parte da Dissertação de Mestrado do primeiro autor apresentada ao Programa de Pós-graduação em Agronomia, Universidade Estadual Paulista "Júlio de Mesquita Filho"/UNESP
[2]Faculdade de Agronomia e Medicina Veterinária, Universidade de Brasília (UnB), Campus Universitário Darcy Ribeiro - ICC Centro – Brasília-DF, Brasil, josecruz08@yahoo.com (ORCID ID 0000-0002-8283-5671)
[3]Departamento de Produção Vegetal, Universidade Estadual Paulista "Júlio de Mesquita Filho"/UNESP, Jaboticabal-SP, Brasil, cibele.chalita@unesp.br (ORCID ID 0000-0002-1720-9252); patriciacandidocs@gmail.com (ORCID ID 0000-0002-3555-5706); renatotbarros@hotmail.com (ORCID ID 0000-0002-0269-8321)
[4]Departamento de Agronomia, Universidade Federal de Jataí, Jataí-GO, Brasil, givanildozildo@gmail.com (ORCID ID 0000-0002-6380-1599)

INTRODUCTION

In Latin America and Africa, *Panicum maximum* 'Mombasa' is used for pasture due to its high dry matter production, high forage quality and tolerance to drought, in addition to its ease of management and acceptance by animals (CANTO *et al*., 2012; DUTRA; RODRIGUES; PEREIRA, 2015).

Human action and the field environment affect the production and quality of grass seeds (SILVA *et al*., 2014), whereas water availability and temperatures during seed development in the field influence the viability of the seeds (CARVALHO; NAKAGAWA, 2012). In seeds of *P. maximum*, viability is evaluated by the tetrazolium test, whose results are used together with those of physical purity for marketing purposes (BRASIL, 2008).

Environmental factors, such as excessive rainfall and strong winds, can cause the florets and immature seeds to fall, increasing the impurity of seed batches harvested by sweeping the ground (SOUZA *et al*., 2015, 2016).

The low physical quality of forage-grass seeds can be attributed to harvesting by ground-sweeping after seedfall (MELO *et al*., 2018), this results in a mixture of seeds, plant debris, earth and stones (SILVA *et al*., 2019).

By evaluating physical purity and viability, it is possible to calculate the PLS. This parameter expresses the percentage of viability and purity as a single index, giving the percentage of pure seeds that can germinate under suitable soil conditions (BRASIL, 1992; MARTINS; LAGO; GROTH, 1998).

The PLS is a technical index used by farmers and the producers of forage-grass seeds as a parameter of the quality and market value of seed batches, which aids in decision-making (LAURA *et al*., 2009). However, Decree no. 16 of 2013 determined that the PLS should no longer appear on seed packaging in Brazil (BRASIL, 2013).

During the physical analysis of batches in the laboratory, seeds of other species may be found, and these reflect the problems that occur during production in the field, such as the inefficient control of invasive plants (ABOUZIENA; HAGGAG, 2016). These plants have the ability to adapt to different climate conditions and develop in different regions (BARROS *et al*., 2017). However, it is difficult to attribute the occurrence of these plants to climate factors, since most are cosmopolitan (ONEN *et al*., 2018).

The contamination of plots by noxious plant species should be avoided by choosing areas free of invasive plants and by the use of weed control. The inspection of seed fields also has the aim of avoiding or minimising the occurrence of weeds (BRASIL, 2011). The presence of seeds of other cultivated species, wild species, and restricted noxious or prohibited noxious species can lead to the entire field being rejected when numbers are greater than those established by the Standards for Seed Marketing (BRASIL, 2013).

Various researchers have found differences in the physical quality of *P. maximum* seeds. However, they did not determine the number of seeds of other species, nor did they relate this quality to the provenance of the seeds (LAURA *et al*., 2009; MELO *et al*., 2016a, b).

The aim of the present study, therefore, was to evaluate the effect of provenance on the viability and physical quality of seeds of *P. maximum* 'Mombasa'.

MATERIAL AND METHODS

Nineteen batches of *P. maximum* 'Mombasa' seeds were evaluated, from four different locations: Auriflama, São Paulo (SP) (Batches 1 to 6), Guzolândia, SP (Batches 7 to 9), Quirinópolis, Goiás (GO) (Batches 10 to 17) and Serranópolis, GO (Batches 18 and 19). The number of batches by location, the geographic coordinates, altitude and characteristics of the regions where the seed batches were collected are shown in Table 1.

After mechanical collection using a ground-sweeping harvester, the seeds were submitted to pre-cleaning in the field using a cylindrical sieve machine (typhoon) connected to the power take-off of a tractor. Each 5 kg batch of unprocessed seeds was homogenised, packed in single-sheet paper packaging, and sent to the Seed Analysis Laboratory of the Plant Production

Table 1 - Origin, number of lots (L), geographic coordinates, altitude (Altit.), average temperature (Temp.), accumulated annual precipitation (Precip.), and climate of the *P. maximum* cv. Mombasa seeds harvest site

Provenance	B	Latitude (S)	Longitude (W)	Alt. (m)	Temp. (ºC)	Rain. (mm)	Climate*
Auriflama, SP	6	18°26’54”	50°27’06”	541	24.4	1.520	Aw
Guzolândia, SP	3	20º38’59”	50º39’43”	442	22.3	1.176	Aw
Quirinópolis, GO	8	20º41’08”	50º33’17”	480	23.5	1.324	Aw
Serranópolis, GO	2	18º18’22”	51º57’44”	718	23.3	1.579	Aw

Source: Climate-data.org, 2019. * Classification as per Köppen and Geiger (1928): Aw (tropical savannah climate with a dry winter season) - the average temperature is always greater than 18 ºC for all months of the year. During the dry winter season, the average rainfall is less than 60 mm for at least one month

Department, Faculty of Agrarian e Veterinary Sciences, Paulista State University, Jaboticabal Campus, SP, where the following parameters were determined:

Moisture content - determined by the oven method at 105 ± 3 ºC for 24 hours. Three subsamples of 2.0 g were weighed on an analytical balance with a readability of 0.001 g, and the data expressed as a percentage on a wet basis (BRASIL, 2009).

Viability by tetrazolium test - four subsamples of 50 seeds were left to soak between moist paper sheets for 18 hours at 30 ºC. The seeds were then split longitudinally through the embryo, and one half of the seed was immersed in a 0.1% tetrazolium solution and kept in a dark room at 37 °C for three hours. After this period, the seeds were washed in running distilled water and the readings taken immediately, classifying the seeds as viable or non-viable. The results were expressed in percentage viability (BRASIL, 2009; TOMAZ *et al*., 2010).

Physical purity – using two subsamples, each of 2.0 g, weighed on a precision balance (0.001 g). The components of each subsample were separated by pneumatic blower and collected manually. The results were expressed as a percentage of pure seeds, inert matter and other seeds (BRASIL, 2009).

Pure Live Seeds - calculated using the formula: PLS = (TZ × P) / 100, where TZ = viable seeds by tetrazolium test; P = physical purity. The results were expressed as a percentage (BRASIL, 1992).

1000-seed weight - determined using eight subsamples of 100 seeds, individually weighed on a precision analytical balance (0.001 g), with the results expressed in grams (BRASIL, 2009).

Number of other seeds - a 20 g sample of seeds was weighed on a precision analytical balance (0.001 g) and the seeds of other species were identified and counted. The seeds were identified by a specialist in the area, using a stereoscopic microscope, consulting the seed collection and the specialised literature. The results were presented as the number of seeds of each species per sample weight (BRASIL, 2009).

Statistical proceedure: the data were submitted to ANOVA in a completely randomised design. The mean values of the batches were compared using the Scott-Knott test at 5% probability.

RESULTS AND DISCUSSION

The moisture content of the 19 batches of *P. maximum* ‘Mombasa’ seeds ranged from 9.7% to 11.8% (Table 2). The maximum difference between these values was 2.1%. This difference was considered acceptable by Silva *et al*. (2019), after finding a difference of 2% in the moisture content of 15 samples of *Urochloa decumbens* ‘Basilisk’ seeds. It is essential for the moisture content of batches to show similar values in order to obtain valid results from the tetrazolium test and when determining the 1000-seed weight, as the results of these variables may vary depending on the moisture content of the seeds (BATISTA; NUNES; NÓBREGA, 2016; BRASIL, 2009).

Seed viability as assessed by the tetrazolium test varied between 70% and 89%. Batches 1 to 4 from Auriflama, Batch 1 from Guzolândia, Batches 1 to 6 from Quirinópolis, and Batch 1 from Serranópolis showed high viability, between 82% and 89%, and were higher than the other batches (Table 2). The viability of the remaining batches was statistically lower, and ranged from 70% to 78%.

Cruz *et al*. (2020) assessed the influence of climate conditions on the physiological quality of *P. maximum* ‘Mombasa’ seeds, and concluded that rainfall and high temperatures during seedfall and harvesting are not favourable for producing adequately viable seeds. In the present study, all the seed batches showed adequate viability, greater than 40%, the official standard for marketing seeds of *P. maximum* (BRASIL, 2008); this was also seen in other studies with seed batches of the same species (FERREIRA; VALLE, 2017; RAGONHA; OLIVEIRA; SILVA, 2018).

Table 2 - Moisture content (MC), viability by tetrazolium test (TZ), pure seeds (P), inert matter (IM), other seeds (OS), PLS and 1000-seed weight (TSW) in 19 seed batches (B) of *P. maximum* ‘Mombasa’ of varying provenance, 2014/2015 harvest

Provenance	B	MC	TZ	P	IM	OS	PLS	TSW
		%						g
Auriflama, SP	1	11.3	88 a	78.3 c	21.6 c	0.14 b	69 b	1.13 f
	2	10.6	83 a	67.7 d	32.3 d	0.05 a	55 c	1.44 c
	3	10.6	88 a	71.1 d	28.7 d	0.05 a	61 b	1.44 c
	4	11.7	82 a	77.1 c	22.8 c	0.07 a	65 b	1.37 e
	5	10.3	77 b	70.4 d	29.6 d	0.07 a	56 c	1.41 d
	6	11.3	74 b	55.9 e	44.0 e	0.08 a	43 d	1.44 c

Continuation Table 2

Guzolândia, SP	1	10.5	82 a	79.4 c	21.2 c	0.07 a	65 b	1.37 e
	2	11.3	76 b	50.9 f	49.1 f	0.04 a	38 d	1.41 d
	3	10.7	70 b	51.1 f	48.9 f	0.04 a	35 d	1.40 d
Quirinópolis, GO	1	10.3	88 a	86.0 b	13.8 b	0.16 b	76 a	1.47 b
	2	9.7	89 a	49.9 f	50.2 f	0.05 a	44 d	1.48 b
	3	9.7	82 a	59.8 e	39.9 e	0.30 d	50 c	1.38 e
	4	10.8	88 a	76.6 c	23.2 c	0.18 b	67 b	1.45 c
	5	10.0	84 a	94.3 a	5.6 a	0.04 a	82 a	1.49 b
	6	11.5	86 a	77.7 c	22.1 c	0.22 c	65 b	1.49 b
	7	9.8	74 b	58.5 e	41.6 e	0.06 a	43 d	1.38 e
	8	11.8	71 b	73.7 d	26.2 d	0.11 a	52 c	1.37 e
Serranópolis, GO	1	10.5	86 a	78.5 c	21.4 c	0.08 a	66 b	1.52 a
	2	9.8	78 b	81.4 c	18.6 c	0.04 a	65 b	1.40 d
F		-	5.5**	62.5**	62.1**	17.0**	22.3**	69.6**
CV (%)		-	6.6	3.9	9.5	32.4	8.3	1.4

** Significant at 1% probability by F-test. Mean values followed by the same letter in a column do not differ statistically by Scott-Knott test at 5% probability

Regarding physical purity, the percentage of pure seeds in the batches varied between 49.9% and 94.3% (Table 2). According to Normative Instruction no. 30 of the Ministry of Agriculture, Fisheries and Supply (MAPA), the minimum required value for purity is 50% when marketing a batch of *P. maximum* seeds (BRASIL, 2008). As such, only Batch 2 from Quirinópolis, was below the required standard (49.9%).

It should be noted that the seed batches used in the present study were unprocessed. The quality, therefore, might be further improved by processing the seeds at the company (MELO *et al*., 2016a; CRUZ *et al*., 2020). Batch 5 from Quirinópolis had a purity of 94.3% and would require no processing, an advantage for the seed company.

Based on the percentage of pure seeds, the batches were classified into five groups. The group with the highest purity comprised Batches 1 and 5 from Quirinópolis, which, although statistically different from each other, were the best of all the batches, with values of 86% and 94.3%, respectively. The group with high to medium purity included Batches 1 and 4, harvested in Auriflama, Batch 1 from Guzolândia, Batch 4 and Batch 6 from Quirinópolis, and Batches 1 and 2 from Serranópolis, and had values between 77% and 81%. The group with medium purity comprised Batches 2, 3 and 5 from Auriflama and Batch 8 from Quirinópolis, with values between 68% and 74%. The group with medium to low purity consisted of Batch 6 from Auriflama, and Batches 3 and 7 from Quirinópolis, with values between 56% and 60%. The group with the lowest purity, comprising Batches 2 and 3 from Guzolândia and Batch 2 from Quirinópolis, had values ranging between 50% and 51%.

Differences in physical purity between seed batches may be the result of differences in the production process between operators, even when the producers use the same system of harvesting. Also, the choice of operator is important, since the care taken during production and pre-cleaning in the field had an obvious effect on the purity of the seed batch. The physical quality of unprocessed, freshly harvested seeds of forage grasses is related to management in the field, ground-sweeping procedures when harvesting, and pre-cleaning in the field (SILVA *et al*., 2019). With mechanical harvesting, periodic adjustment of the machine is essential to prevent impurities from being collected in excess or not being effectively removed, so as not to affect the physical quality of the seeds (MASCHIETTO, 2013).

Physical quality is more dependent on procedures in the field, such as management, and pre-cleaning and adjusting the machines during harvesting, than on the climate conditions at the place of origin of the seeds (SILVA *et al*., 2019).

Among the impurities found in the 19 batches were straw, stones, clods and immature seeds, including a smaller percentage of the seeds of other species. As such, inert matter was the most common impurity found in the seed batches, with percentagevalues that were almost equal to those found for pure seeds. These results corroborate those from a purity analysis of the seeds of *Urochloa decumbens* ‘Basilisk’ (SILVA *et al*., 2019).

As a result, the statistical classification of the seed batches as to inert matter was identical to that obtained for pure seeds. The highest percentage of inert matter was found in Batches 2 and 3 from Guzolândia and Batch 2 from Quirinópolis, with 49.1%, 48.9% and 50.2% inert matter, respectively (Table 2). In those cases, processing at the seed company should be more rigorous, with a greater amount of discarded material than in other batches, since almost half of the material collected (unprocessed seeds) was composed of impurities. Processing removes the impurities from batches to meet the established standards of physical quality for seeds on the domestic market (MELO *et al*., 2016b).

The worst batches, with the highest incidence of other seeds, were Batch 3 (0.30%) and Batch 6 (0.22%) from Quirinópolis. Other batches such as Batch 1 from Auriflama, and Batches 1 and 4 from Quirinópolis, had a medium number of other seeds, with 0.14%, 0.16% and 0.18%, respectively, as shown in Table 2. The remaining batches had a significantly lower percentage, with values of less than 0.1%. This suggests that invasive plants were better controlled when producing these batches, as verified by Silva *et al.* (2019).

The presence of diaspores of other species in the seed batches reflects a failure by the operator and technician responsible to control the weeds or inspect the production field (CARVALHO; NAKAGAWA, 2012). This emphasises the importance of carefully choosing operators and technicians who are qualified in seed production.

The PLS expresses the physical and physiological quality of seed batches as a single index. For the 19 seed batches of *P. maximum* ‘Mombasa’ the PLS varied from 35% to 82%. However, according to Laura *et al.* (2009), the average value in Brazil is 30%, meaning that for each of the batches under evaluation, the PLS was above the national average.

The batches were classified into four groups based on their PLS. The group with the highest PLS comprised Batches 1 and 5 from Quirinópolis, with values of 76% and 82%, respectively. The group with a medium to high PLS included Batches 1, 3 and 4 from Auriflama, Batch 1 from Guzolândia, Batch 4 and Batch 6 from Quirinópolis, and Batches 1 and 2 from Serranópolis, with values between 61% and 69%. The group with a medium to low PLS comprised Batches 2 and 5 from Auriflama, and Batches 3 and 8 from Quirinópolis, with values between 50% and 56%. The group with the lowest PLS consisted of Batch 6 from Auriflama, Batch 2 and Batch 3 from Guzolândia, and Batches 2 and 7 from Quirinópolis, with values between 35% and 44%.

The PLS expresses viability and purity as a single variable (BRASIL, 1992). The observed values show that each place of origin was suitable for the production of forage-grass seeds, allowing them to be marketed in accordance with the legislation, with no need for processing.

Based on the 1000-seed weight, the batches were classified into five groups: the group with the highest weight comprised Batch 1 from Serranópolis, and Batches 1, 2, 5 and 6 from Quirinópolis, although the first batch was statistically superior to the others. These batches had a 1000-seed weight of between 1.47 and 1.52 g.

The group with a high to medium 1000-seed weight consisted of Batches 2, 3 and 6 from Auriflama and Batch 4 from Quirinópolis, with values between 1.44 and 1.45 g. The group of medium weight included Batch 5 from Auriflama, Batches 2 and 3 from Guzolândia and Batch 2 from Serranópolis, and presented values between 1.40 and 1.41 g. The group with a medium to low weight comprised Batch 4 from Auriflama, Batch 1 from Guzolândia, and Batches 3, 7 and 8 from Quirinópolis, with values between 1.37 and 1.38 g. The group with the lowest weight (1.13 g) consisted of Batch 1 from Auriflama.

The higher seed weights may be due to favourable climate conditions during flowering and seed filling, such as rainfall, favourable temperatures and luminosity conducive to photosynthesis, plant metabolism, and the synthesis of reserves accumulated in the seeds during maturation (BARROS *et al*., 2017; CARVALHO; NAKAGAWA, 2012; CRUZ *et al*., 2020; LAMARCA *et al*., 2013). In addition to the climate conditions, seed weight can be influenced by the time of the harvest, field management, plant nutrition, competition from weeds, and phytosanitary treatments (LAURA *et al*., 2009).

When determining the number of seeds of other species, 26 species were identified in the 19 batches under evaluation: two cultivated species (*Urochloa* sp. and *Crotalaria lanceolata*), 13 wild invasive species, ten restricted noxious-weed species, and one prohibited noxious-weed species (Table 3). The seeds of other cultivated species, wild invasive species, and restricted and prohibited noxious-weed species were found in 53%, 79%, 89% and 16% of the batches, respectively.

Seeds of the prohibited noxious species *Cyperus* sp. (BRASIL, 2008) were found in Batches 1 and 3 from Quirinópolis and Batch 2 from Serranópolis. As such, 25% and 50%, respectively, of the batches from these districts contained prohibited seeds. These batches would be rejected and could not be marketed, due to not meeting the Norms and Standards for the Production and Marketing of Seeds of Tropical Forage Species (BRASIL, 2008).

Noxious seeds are from species that, as they are hard to eradicate in the field or during processing, are harmful to the crop or its product, and are restricted by specific Norms and Standards (BRASIL, 2008, 2009).

Table 3 – Number of other seeds by cultivated species, wild invasive species, and restricted and prohibited noxious-weed species, in 19 seed batches of *P. maximum* 'Mombasa' from the districts of Auriflama, SP (Aur.), Guzolândia, SP (Guz.), Quirinópolis, GO (Qui.) and Serranópolis, GO (Ser.), 2014/2015 harvest

Batches	Aur.						Guz.			Qui.								Ser.	
	1	2	3	4	5	6	1	2	3	1	2	3	4	5	6	7	8	1	2
Other cultivated species* (20 g)																			
Urochloa sp.	1	0	0	0	0	1	0	0	1	9	5	5	11	0	3	3	3	0	0
Crotalaria lanceolata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	0	0	0	0	1	0	0	1	9	5	5	11	0	3	3	3	0	0
Wild invasive species* (20 g)																			
Bidens sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Chenopodium album	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0
Commelina benghalensis	0	0	0	0	6	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Croton glandulosus	0	0	0	0	0	0	0	0	0	9	0	2	0	0	13	2	0	0	0
Desmodium sp.	2	0	0	0	1	0	4	1	0	3	0	0	0	0	0	0	0	0	0
Desmodium tortuosum	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Indiagofera hirsuta	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phyllanthus sp.	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Richardia brasiliensis	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna occidentalis	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Senna tora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sesbania exaltata	1	2	0	2	3	1	13	0	1	0	0	0	1	0	0	0	0	0	0
Spermacoce latifolia	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0	1
Total	8	2	0	6	11	3	17	2	2	16	0	5	1	2	15	2	0	0	1
Restricted noxious species* (20 g)																			
Amaranthus sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Digitaria insularis	0	1	0	2	2	0	0	0	0	23	0	1	8	0	3	0	3	0	0
Diodia teres	0	0	0	0	0	0	0	0	0	1	0	6	0	0	2	0	3	0	0
Echinochoa sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyptis suaveolens	0	0	0	0	0	0	0	0	0	17	0	1	0	0	0	0	1	0	1
Ipomea sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex obtusifolius	27	3	1	1	2	2	24	2	0	5	0	1	0	1	0	2	1	0	1
Sida cordifolia	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sida rhombifolia	0	0	2	0	1	0	0	1	0	0	0	0	0	1	0	1	1	0	0
Solanum sp.	1	0	0	2	1	0	0	0	0	0	0	0	0	1	0	0	1	9	1
Total	29	4	3	7	6	2	24	3	0	46	0	10	8	3	5	3	10	9	3
Prohibited noxious species* (20 g)																			
Cyperus sp.	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	2
Total	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	2

* Classification as per Normative Instruction no. 30 of 21 May 2008 (Annex VI) of the Ministry of Agriculture, Fisheries and Supply

According to Annex VI of Normative Instruction no. 30 of 2008, published by MAPA (BRASIL, 2008), batches that contain a maximum of 30 seeds of other cultivated species, 40 seeds of wild invasive species, and 50 seeds of restricted noxious species can be used for marketing.

Therefore, except for the batches that were rejected due to the occurrence of prohibited weed species, the remaining batches would be suitable for marketing, as they did not exceed the maximum number of restricted species allowed by the Norms and Standards for the Production and Marketing of Seeds of Tropical Forage Species (BRASIL, 2008).

Seeds of *Cyperus rotundus,* found in the batches in the present study, were also found by Borghi *et al*. (2008) in seed fields for either forage grass or the production of pasture. This species is aggressive and difficult to control (MENDONÇA *et al*., 2014; SCARIOT *et al*., 2017).

Seeds of other cultivated species were found in 88%, 33% and 33% of the batches from Quirinópolis, Auriflama and Guzolândia, respectively. None of the batches from Serranópolis contained seeds of other cultivated species. Seeds of wild species were found in all the batches from Guzolândia, 83% of the batches from Auriflama, 75% of the batches from Quirinópolis and 50% of the batches from Serranópolis. The seeds of wild species are common, but easy to control or separate during processing (BRASIL, 2009).

Seeds of restricted noxious weeds were found in 100%, 100%, 88% and 67% of the batches from Auriflama, Serranópolis, Quirinópolis, and Guzolândia, respectively. The presence of weeds in production fields may be related to their easy propagation and to ineffective weed management (ONEN *et al*., 2018).

To minimise problems with seeds of other species in seed batches of a particular crop, specific weed-management practices should be adopted while still in the field, considering the distribution of the weeds, the fertility of the soil, climate conditions and crop management practices (irrigation, fertilisation, and the use of herbicides) (ONEN *et al*., 2018).

Processing can be used to completely or partially remove the seeds of weeds and other undesired species that are found in the seed batches (BRASIL, 2011; MELO *et al*., 2016a, b; SILVA *et al*., 2019). However, the efficiency of the operation depends on the presence of physical differences between the forage-grass seeds and any seeds that should be removed from the batch (MELO *et al*., 2016a).

CONCLUSIONS

1. The physical quality and viability of seeds of *P. maximum* ‘Mombasa’ are affected by their provenance;
2. All the batches have seeds of sufficient viability to meet marketing standards;
3. Based on physical purity, Batch 2 from Quirinópolis should not be marketed.
4. Based on an examination of noxious seeds, 85% of the batches are suitable for marketing.

ACKNOWLEDGMENT

This study was carried out with the support of the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasil (CAPES) - Finance Code 001.

REFERENCES

ABOUZIENA, H. F.; HAGGAG, W. M. Weed control in clean agriculture: a review. **Planta Daninha**, v. 34, n. 2, p. 377-392, 2016.

BARROS, R. T. D. *et al*. Origin and temperature on the germination of beggartick seeds. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v. 21, n. 7, p. 448-453, 2017.

BATISTA, V. T.; NUNES, J. V. D.; NÓBREGA, L. H. P. Qualidade fisiológica de sementes de *Brachiaria brizantha* cv. Marandu com variação nas características de pureza. **Revista de Agricultura**, v. 91, n. 1, p. 92-100, 2016.

BORGHI, E. *et al*. Influência da distribuição espacial do milho e da *Brachiaria brizantha* consorciados sobre a população de plantas daninhas em sistema plantio direto na palha. **Planta Daninha**, v. 26, n. 3, p. 559-568, 2008.

BRASIL. Ministério da Agricultura, do Abastecimento e da Reforma Agrária. **Regra para análise de sementes**. Brasília: MAPA/ACS, 1992. 365 p.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Guia de inspeção de campos para produção de sementes**. 3. ed. Brasília: MAPA/ACS, 2011. 41 p.

BRASIL. Ministério da Agricultura, Pecuária e do Abastecimento. Instrução Normativa nº 30, de 21 de maio de 2008. **Diário Oficial da União**: seção 1, Brasília, DF, p. 45, 23 maio 2008.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 45, de 17 de setembro de 2013. **Diário Oficial [da] República Federativa do Brasil**: seção 1, Brasília, DF, p. 38, 20 set. 2013.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Regras para análise de sementes**. Brasília: MAPA/ACS, 2009. 399 p.

CANTO, M. W. *et al.* Produção e qualidade de sementes do capim-mombaça em função da adubação nitrogenada. **Bragantia**, v. 71, n. 3, p. 430-437, 2012.

CARVALHO, N. M.; NAKAGAWA, J. **Sementes**: ciência, tecnologia e produção. Jaboticabal: FUNEP, 2012. 590 p.

CRUZ, J. O. *et al*. Production fields and physiological quality of *Panicum maximum* Jacq. cv. Mombasa seeds. **Bioscience Journal**, v. 36, n. 6, p. 2050-2059, 2020.

DUTRA, J. C.; RODRIGUES, A. P. D. C.; PEREIRA, S. R. Heat treatment to overcome seeds dormancy of *Panicum maximum* cultivars (Poaceae). **African Journal of Agricultural Research**, v. 10, n. 50, p. 4616-4622, 2015.

FERREIRA, P. N. A.; VALLE, L. A. C. Qualidade de sementes revestidas de gramíneas forrageiras tropicais analisadas no LASO/LANAGRO/MG. **Políticas e Saúde Coletiva**, v. 2, n. 3, p. 1-14, 2017.

KÖPPEN, W.; GEIGER, R. **Klimate der Erde**. Gotha: Verlag Justus Perthes. 1928. Wall-map 150cmx200cm.

LAMARCA, E. V. *et al.* Maturation of *Eugenia pyriformis* seeds under different hydric and thermal conditions. **Anais da Academia Brasileira de Ciências**, v. 85, n. 1, p. 223-233, 2013.

LAURA, V. A. *et al.* Qualidade física e fisiológica de sementes de braquiárias comercializadas em Campo Grande – MS. **Ciência e Agrotecnologia**, v. 33, n. 1, p. 326-332, 2009.

MARTINS, L.; LAGO, A. A.; GROTH, D. Valor cultural de sementes de *Brachiaria brizantha* (Hochst. Ex A. Rich) Stapf durante o armazenamento. **Revista Brasileira de Sementes**, v. 20, n. 1, p. 60-64, 1998.

MASCHIETTO, J. C.; O “rally” da fiscalização de campo. **Revista JC Maschietto**, v. 1, n. 11, 2013.

MELO, L. F. *et al.* Beneficiamento na qualidade física e fisiológica de sementes de capim-mombaça. **Revista Ciência Agronômica**, v. 47, n. 4, p. 667-674, 2016a.

MELO, L. F. *et al.* Effects of processing phases on the quality of massai grass seeds. **Revista Ciência Agronômica**, v. 49, n. 2, p. 259-266, 2018.

MELO, L. F. *et al.* Processing in the quality of tanzania grass seeds. **Revista Engenharia Agricola**, v. 36, n. 6, p. 1157-1166, 2016b.

MENDONÇA, V. Z. *et al.* Corn production for silage intercropped with forage in the farming-cattle breeding integration. **Revista Engenharia Agrícola**, v. 34, n. 4, p. 738-745, 2014.

ONEN, H. *et al.* Weed flora of citrus orchards and factors affecting its distribution in western mediterranean region of turkey. **Planta Daninha**, v. 36, p. 1-14, 2018.

RAGONHA, E. P.; OLIVEIRA, G. O.; SILVA, D. C. B. Comparação dos testes de germinação e tetrazólio para análise de vigor de sementes de forrageiras. **Tecnologia, Ciência e Agropecuária**, v. 12, n. 2, p. 63-66, 2018.

SCARIOT, E. *et al.* Aqueous extract of *Cyperus rotundus* on the rooting of *Prunus persica* cv. ‘Chimarrita’ cuttings. **Revista de Ciências Agroveterinárias**, v. 16, n. 2, p. 195-200, 2017.

SILVA, A. L. M. S. *et al.* Tratamentos para quebra de dormência em *Brachiaria brizantha*. **Revista Ciências Agrárias**, v. 37, n. 1, p. 37-41, 2014.

SILVA, G. Z. *et al.* Production regions and physical quality of *Urochloa decumbens* cv. Basilisk. **Bioscience Journal**, v. 35, n. 1, p. 236-243. 2019.

SOUZA, F. H. D. *et al.* Manejo de campos de produção de sementes de *Urochloa humidicola* ‘comum’: II - efeito de práticas culturais. **Boletim da Indústria Animal**, v. 72, n. 3, p. 209-220, 2015.

SOUZA, F. H. D. *et al.* **Produção comercial de sementes de *Brachiaria* (syn. *Urochloa*) *humidicola* no Brasil**. São Carlos: Embrapa Pecuária Sudeste (INFOTECA), 2016. 43 p.

TOMAZ, C. A. *et al.* Duração do teste de germinação do capim-tanzânia. **Revista Brasileira de Sementes**, v. 32, n. 4, p. 80-87, 2010.