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Evaluación de semilla de pastos cosechados en caminos y campos de cultivos

Seed evaluation of harvested pastures in roads and crop fields

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RESUMEN

Se evaluó la calidad fisiológica y física de la semilla de los pastos *Sporobolus aeroides*, *Bouteloua curtipendula*, *Briza minor*, *Bromus mollis*, *Chencrus ciliaris*, *Rhynchelytrum repens*, *Eragrostis curvula*, *Bouteloua gracilis*, *Setaria geniculata, Leptochloa filiformis*, *Bothriochloa perforata* y *Digitaria califórnica,* recolectados en Soledad de Graciano Sánchez, S. L. P., México, en los años 2013, 2014 y 2015. Se determinó el porcentaje de germinación (PGER), semilla muerta (SM), peso seco de plántula (PSP), altura de plántula (ALTP), pureza analítica (PA), peso de mil semillas (PMS) y peso volumétrico (PV). El mayor PGER fue para Pega Ropa 2014 con 91.7%, y la mínima en Banderita 2014 con 23.2%. Para SM Popotillo Plateado 2013 mostró el mayor porcentaje (9.5%). Para PSP el pasto Carretero 2014 presentó el mayor valor con 0.6266 g 20 pl^{-1}. Para ALTP el pasto Punta Blanca 2014 presentó el mayor valor con 15.25 mm. Para PA para el año 2013 el zacate Alcalino obtuvo un 100%, Plumilla 2013 presentó 69.66%, en 2014 el pasto Alcalino mostró un 100% y Buffel el más bajo con un 65%. Para PV el Alcalino 2015 mostró el mayor valor con 64.32 kg hl^{-1}. Se concluye que la evaluación de las semillas mostró variabilidad en calidad.

Palabras clave: pastos nativos, germinación, plántula, pureza, peso.

ABSTRACT

The physiological and physical quality of the grass seed *Sporobolus aeroides*, *Bouteloua curtipendula*, *Briza minor*, *Bromus mollis*, *Chencrus ciliaris*, *Rhynchelytrum repens*, *Eragrostis curvula*, *Bouteloua gracilis*, *Setaria geniculata, Leptochloa filiformis*, *Bothriochloa perforata* y *Digitaria califórnica* collected in Soledad de Graciano Sánchez, S. L. P, Mexico, in the years 2013, 2014 and 2015. The percentage of germination (PGER), dead seed (DS), seedling dry weight (SDW), seedling height (SH), analytical purity (AP), thousand seed weight (TSW) and volumetric weight (VW) were evaluated. The largest PGER was for Pega Ropa 2014 with 91.7%, and the minimum in Banderita 2014 with 23.2%. For DS Popotillo Plateado 2013 showed the highest percentage (9.5%). For SDW, Carretero grass 2014 presented the highest value with 0.6266 g for 20 seedlings. For SH, Punta Blanca grass 2014 presented the highest value with 15.25 mm. For AP for the year 2013 the Alcalino grass obtained a 100%, Plumilla 2013 presented 69.66%, in 2014 the Alcalino grass showed 100% and Buffel the lowest with 65%. For VW the Alcalino 2015 showed the highest value with 64.32 kg hl^{-1}. It is concluded that the evaluation of the seeds showed variability in quality.

Key words: native pastures, germination, seedling, purity, weight.

INTRODUCTION

Seed demand in Mexico is a direct function of the production potential, which is determined by its genetic, physical, physiological and health quality, as well as its mechanical damage. It is well known that in trade there are few improved varieties and to a very high degree native species, which are produced by applying little modern and/or traditional-craft technology, as well as crops grown on roads, on cultivated or abandoned land. However, because the marketing of locally forage seeds is in bulk, or in rustic containers of unknown origin, and quality standards are unknown, which is of the utmost importance because it is necessary to know the favorable or unfavorable factors of the production that occurred during the formation and development of the seed at the field level, which has repercussions on poor quality seeds that do not assure good establishments of grassland and pastures due to low germination and little emergence of seedlings. A high pasture density in pastures and grasslands represents the best opportunity to rapidly increase plant cover in cattle ranches in arid and semi-arid zones with high proportion of soil exposed to erosion and without vegetation cover.

Greater pasture density offers the opportunity to increase the sun and rain harvest, which forms the basis of a high profitability in grazing production systems, while at the same time preserving the ecological stability of arid ecosystems. Grasses are not domesticated species and low germination is a characteristic of pasture grasses, which reduces the effectiveness of planting meadows of temporary grasses. The commercial seed of pastures is not only considered to the caryopsis to the botanical seed; also includes various types of accessory bracts of the caryopsis, such as gluma, palea and modified branches (Hanna and Anderson, 2008). The grass seed does not germinate completely under optimal conditions of humidity and temperature. The above occurs because these species have not been domesticated and differ in germination time. Through 60 million years of history, pastures have evolved according to various factors and because of this their germinative capacity is distributed over a period of time allowing them to persist as a species. It is important to take care of the seed quality that will be used to test germination and vigor (Enríquez *et al*., 2011). The most common causes of latency are the presence of an oxygen-and water-impermeable seed sheath, embryo immaturity and the presence of inhibitors that prevent or control germination. The effects on germination are variable and considerable variations are observed between species, eco types, sites and years of harvest (Tian *et al*., 2002). It is also important to properly handle the seed before storing it for good quality. The cleaning of the seed consists of removing from it all undesirable plant parts such as: dry leaves, stems and immature spikes. For this, sieves of different calibers in cm^2 can be used, through which the seed is passed and allow the separation of particles according to their size (Antón, *et al*., 2005). Once the seed is harvested, it is allowed to dry in the shade until the moisture content is reduced to 10-14%. This can be estimated with a specific seed moisture apparatus. For the above, the drying should be carried out in an area where it can be maneuvered easily, preferably in a cement floor and smooth. In this, the seed extends in layers no larger than 10 cm, which must be turned every 20 min using a fork or blades, to be uniform; since humidity and temperature are the factors that influence the conservation of seeds during storage (Durán and Retamal, 1996).

The dry seed is placed in sacks and stored for a period of six months before sowing, in a dry and cool place, preferably with air extractors and well aerated where the average temperature does not exceed 30 ºC. It is important to place the bags with the seed on wooden pallets to avoid direct contact with the moisture of the floor which can affect it. If it is stored with humidity greater than 14%, this will result in death of the seed by heating and presence of fungi. It is advisable that seeds can be stored in the form of thin layers, well ventilated, protected against birds and rodents, and protected with rains (Doria, 2010). For all of the above, it was proposed to evaluate the physical and physiological quality of the seed of native and introduced grasses harvested on the roads and crop fields.

MATERIAL AND METHODS

The present study was carried out in the Laboratory of Parasitology of the Faculty of Agronomy and Veterinary of the Autonomous University of San Luis Potosí (UASLP), located in the geographical coordinates at 22º 12'Latitud Norte and 100º 51 'West Longitude of the Meridian from Greenwich to 1835 m.a.s.l The classification of the climate according to Köeppen corresponds to the formula BS kw "(w) (i '), which equates to a dry steppe cold climate, with average annual temperatures of 18 ºC being 7.5 ºC the minimum and 35 ºC the maximum, with the months more hot during May, June and July, with frost from early October to early April. The annual precipitation is 350 mm.

Twelve species of forage grasses collected in the state of San Luis Potosí in the years 2013, 2014 and 2015 were used, reason why their quality standards are not known. The species studied were: Alcalino, Banderite, Briza, Bromus, Buffel, Carretero, Llorón, Navajita, Pega Ropa, Plumilla, Popotillo plateado and Punta Blanca, which were considered as treatments (Table 1).

Table 1. Relationship of genotypes of grasses harvested and evaluated

Common name	Scientific name	Year of collection
Alcalino	*Sporobolus aeroides*	2013, 2014, 2015
Banderita	*Bouteloua curtipendula*	2014
Briza	*Briza minor*	2013, 2014, 2015
Bromus	*Bromus mollis*	2015
Buffel	*Chencrus ciliaris*	2013, 2014, 2015
Carretero	*Rhynchelytrum repens*	2014
Llorón	*Eragrostis curvula*	2013, 2015
Navajita	*Bouteloua gracilis*	2013
Pega ropa	*Setaria geniculata*	2014
Plumilla	*Leptochloa filiformis*	2013
Popotillo plateado	*Bothriochloa perforata*	2013
Punta blanca	*Digitaria californica*	2013, 2014

Assessment of Physical quality

Purity analysis (AP). From the 0.5 kg sample, a sub-sample was taken at random for purity analysis. The weight in grams was determined using the decimal approximation fraction of pure seed and inert matter; seeds of other species contained in the sample were also counted, as described by ISTA (2013). The subsample of each variety were: Alcalino 1.0 g, Banderita 6.0 g, Briza 3.0 g, Bromus 10 g, Buffel 9.0 g, Carretero 6.0 g, Llorón 3.0 g, Navajita 6.0 g, Pega Ropa 9.0 g, Plumilla 9.0 g, Popotillo plateado 9.0 g and Punta Blanca 9.0 g.

Weight of one thousand seeds (PMS). Using the pure seed, 8 replicates of 100 seeds of each treatment were counted, and weighed in a PRECISA model BJ2200C digital scale with an accuracy of 0.01 g. The variance, the standard deviation and the coefficient of variation were calculated as follows:

where:

$$S^{2}=\frac{1}{n-1}\left[\sum_{i=1}^{n} X_1^2-\frac{(\sum_{i-1}^{n} Xi)^2}{n}\right]$$

S^2 = variance
Xi = weight in grams of each replicate of 100 seeds
n = number of repetitions (8)
$\sum_{i-1}^{n}$ =Summation; i=1,…n

$$C.V.=\frac{S}{X}x100$$

where:
C.V = Coefficient of variation (%)
$\frac{S}{X}$=Arithmetic mean of 100 seed weight
S=standard deviation

Like the C.V. was less than 6%, the weight of 1000 seeds was calculated by multiplying the mean of each treatment by 10 (Moreno, 1996).

Volumetric weight (PV). It was obtained in three replicates of the working sample and the pure seed fraction. The PV was calculated by dividing the weight of 3 g of seed between the volume in mL occupied by this quantity and multiplying by 100. To measure the volume was used a graduated test tube of 50 mL.

Percentage of humidity (PHUM). Two replicates of 10 g of pure seed were dried in the oven at 70 °C for 72 hours, and the average moisture content on a wet basis was determined using the following expression:

$$PHUM=\frac{\text{INITIAL WEIGHT}-\text{FINAL WEIGHT}}{\text{INITIAL WEIGHT}}X100$$

Evaluation of physiological quality

Percentage of Germination (PG): The physiological quality in the laboratory was determined with the standard germination test. Following the ISTA (2013) indications, from each treatment, 4 replicates of 100 seeds were established and left for 28 days at 22 °C in the germinating chamber. The seeds of each replicate were distributed in sterile Petri dishes, with a paper towel as substrate, which was moistened with distilled water, and distributed in the interior of the germinating chamber based on the respective randomization. The initial germination percentage (PG1) was measured 7 days after the start of the test and the final germination percentage (PG2) was measured at 28 days after the start of the test.

Dry seedling weight (PSP). This variable was determined by weighing with a PRECISA model BJ2200 digital scale with accuracy of 0.01 g to 20 normal seedlings, after drying in the oven for 72 hours at 70 °C.

Vigor. It was determined on a scale of 1 to 5, where 1 corresponds to the highest vigor and 4 to the lowest vigor, observing the seedlings physically at 28 days of emergency in their petri dish.

Univariate analysis of variance (ANOVA) was performed. Significant variables were submitted to the means comparison test (Tukey, $\alpha = 0.05$), using the SAS package (SAS, 2004). A completely randomized design with 4 replicates was used to evaluate the physiological quality of the seed in laboratory conditions, three replicates for the volumetric weight and moisture content tests, eight for the determination of the weight of 1000 seeds.

RESULTS AND DISCUSSION

Different values were observed in the purity percentages for each of the different evaluated species (Table 2). It is shown that in the seeds harvested in the year 2013 a percentage of 100% was obtained in the Alcalino grass, while the Plumilla grass seed presented percentages of 69.66%. Regarding the year 2014 the seed of the Alcalino grass showed a 100% purity and the lowest percentage in this year was for the seed of the Buffel grass with 65% and for the year 2015 the seed that presented the highest percentage of purity was of the Briza grass, being that of the Llorón grass the lowest in this parameter. The genotypes that showed 100% were above the SNICS rule when they exceeded 98% of purity, a value that marks the Minimum Seed Certification Act of the SNICS (2014) and that are considered for the certification of seeds in Mexico for other forage species. In contrast, the other species evaluated did not knowt this requirement, therefore, should not be commercialized considering this parameter, instead it is possible to observe that commercial houses in Mexico if they market them, putting at risk the establishments of forage crops by producers, which will be reflected in a loss of money for the use of seeds with a high and considerable amount of impurities.

Table 2. Percent purity in seeds of 12 forage grasses. Soledad de Graciano Sánchez S.L.P. 2014 and 2015.

Treatment	2013	2014	2015
Alcalino	100.0	100.0	92.0
Banderita		96.2	
Briza	99.7	87.0	95.3
Bromus			91.7
Buffel	71.3	65.0	66.2
Carretero		70.33	
Llorón	27.3		55
Navajita	73.3		
Pega ropa		99.3	
Plumilla	69.7		
Popotillo plateado	69.7		
Punta blanca		90.8	91.2

In the PV variable, it is observed that there is a significant difference among the genotypes (Table 3), with the result that the Alcalino genotype harvested in the year 2015 showed the highest PV with 64.32 kg hl^{-1}, while Buffel grass of 2014 presented the percentage of the genotypes studied with a result of 16.21 kg hl^{-1}. This may be due to seed exposure to adverse climatic factors, as well as to the fact that the seeds were studied completely, with all their botanical structures such as glumes.

Regarding PMS, the analysis showed significant differences (Table 3), indicating that the weight of the seeds varies among genotypes, the seed that showed the largest size was of the Carretero pasture with 0.7071 g/thousand seeds, which demonstrates the variation of PMS within seed lots of the same species, which may be due to various factors such as harvest time, plant nutrition, competition between plants and environmental effects such as frost and drought. On the basis of this, it is of the utmost importance to acquire seeds having uniform sizes, to ensure better weights and probably to obtain better yields, as mentioned by Gun (1972), in the sense that low-weight seeds represent a problem and adversely affect production standards. The values shown in this study were lower than those obtained by Carrillo *et al*. (2009) that obtained 956 seeds/g for Banderita, 1345 seeds/g for Navajita and for Llorón grass 2165 seeds/g.

In the ALTP variable, there were significant differences between the genotypes (Table 3), where the genotype with the highest height value was the white tip grass, followed by Banderita grass with 12.0 mm. The height of the plant is an evidence of the growth potential of the seedlings which confers some security and better establishment of grasslands.

The PSP had significant differences between the genotypes (Table 3), being Carretero pasture the one with the highest value with 0.566 g for 20 seedlings. The lowest value was presented by the genus Briza 2014 with 0.233 g. Generally the seedlings of the larger seeds have the highest dry weight, possibly due to a higher content of reserve substances, thus producing more vigorous plants. The PSP is of great importance, since when observing which varieties present the greater, it supposes that these are of better vigor and can be decided more effectively which to use, in order to assure better establishments in the field.

In terms of vigor, the data show that there were significant differences between genotypes (Table 3), where the Punta Blanca, Penumilla, Pega Ropa, Navajita and Llorón grasses showed the greatest seedling vigor, corresponding to the highest dry weight of the seedling, which proves that PSP is determinant for a good and rapid growth of the seedlings, that will surely be determinant in the establishment in the field. Therefore, it is suggested that in future investigations more extensive studies on the subject and the establishment in the field and to make correlations to determine this association.

Table 3. Analysis of means of physical quality variables of seeds of twelve forages species. Soledad de Graciano Sánchez, S.L.P. 2015.

GENOTYPE	PVOL (Kg hl^{-1})	PMS (g)	ALTP (mm)	PSP (g)	VIGOR
Alcalino 2014	64.32 a	0.612 ef	11.25 bc	0.3166 de	2.00 c
Alcalino 2015	65.23 a	0.605 f	7.50 def	0.3900 bcde	2.00 c
Banderita 2014	31.03 cd	0.682 d	12.0 b	0.3633 cde	2.00 c
Briza 2013	28.57 e	0.591 f	11.75 b	0.2366 e	2.00 c
Briza 2014	28.84 de	0.571 f	7.25 defg	0.2333 e	3.00 b
Briza 2015	28.48 e	0.601 f	6.75 efgh	0.3133 de	3.00 b
Bromus 2015	18.10 gh	0.982 a	5.75 efghi	0.5333 abc	3.00 b
Buffel 2013	16.30 h	0.767 c	10.25bcd	0.5700 ab	3.00 b
Buffel 2014	16.21 h	0.873 b	8.25 cde	0.6066 a	3.00 b
Carretero 2014	16.27 h	0.771 c	7.50 def	0.6266 a	3.00 b
Llorón 2013	20.92 f	0.582 f	3.50 i	0.5100 abcd	4.00 a
Llorón 2015	36.14 b	0.665 d	4.00 ghi	0.6133 a	4.00 a
Navajita 2013	31.91 c	0.612 ef	4.75 fghi	0.6133 a	4.00 a
Pega ropa 2014	31.26 c	0.676 d	4.25 ghi	0.6066 a	4.00 a
Plumilla 2013	64.32 a	0.622 de	5.50 efghi	0.5966 a	4.00 a
Popotillo plateado 2013	19.52 fg	0.751 d	3.50 i	0.5166 abc	4.00 a
Punta blanca 2013	18.12 gh	0.688 d	13.25 ab	0.3666 cde	2.00 c
Punta blanca 2014	17.27 gh	0.682 d	15.25	0.3766 bcde	2.00 c
Mean	30.036	.7250	7.9027	0.4661	3.17
DMS	2.3212	.0472	3.016	0.1995	0

Means with the same letter a, b, c are statistically equal by column (Tukey, α= 0.05) PVOL= volumetric weight. PMS= weight of a thousand seeds, PSP= seedling dry weight.

Within PG1, it was shown that there were significant differences between the genotypes (Table 4), where the highest value was presented in the genotype Punta Blanca 2013, while the Navajita 2013 genotype showed the lowest percentage remaining far below the treatments compared. The bad emergency is due to factors such as the inability of the seed to germinate (Ellis and Roberts, 1983). Pill and Necker (2001) point out that it is possible to improve the viability of seeds with water conditioning treatments, since they germinated faster than the untreated seeds at any germination temperature, although the percentage of germination did not increase

In relation to PG2, it was determined that there are significant differences (Table 4), where the highest percentage of germination at the second count was presented in the treatment corresponding to the genotype Pega Ropa 2014, while genotype which presented the lowest value was the Banderita grass. According to the results it can be observed that there is great variability in seed germination of the different genotypes of pastures and in their collection years, as observed by Sáenz-Flores *et al*. (2015), who when evaluating seeds of different genotypes with different levels of fertilization observed values ranging from 6.5 to 96.5% of germination. In contrast, Carrillo *et al*. (2009), observed a lower germination for Banderita with 60%, for Navajita 68% and for Llorón 67%.

Table 4. Evaluation of physiological quality variables of twelve forage grass seeds. Soledad de Graciano Sánchez, S.L.P. 2015.

GENOTYPE	PG1	PG2	HARD SEED	DEAD SEED
Alcalino 2014	30.0 cde	35.7 f	57.2 c	7.0 abcdef
Alcalino 2015	17.0 ef	26.2 g	68.0 a	5.7 abcdef
Banderita 2014	17.0 ef	23.2 g	70.2 b	6.7 abcdef
Briza 2013	15.2 f	63.2 de	28.2 def	8.5 abcd
Briza 2014	21.7def	68.7 cd	23.2 efg	8.0 abcde
Briza 2015	33.7 cd	79.5 bc	17.5 gh	3.0 ef
Bromus 2015	47.2 b	74.2 cd	21.7 efg	4.0 cdef
Buffel 2013	22.2 def	67.2 d	29.7 de	3.0 ef
Buffel 2014	19.5 ef	68.5 cd	26.2 defg	5.0 abcdef
Carretero 2014	18.2 ef	72.0 cd	23.0 efg	5.0 abcdef
Lloron 2013	18.2 ef	71.7 cd	24.0 efg	4.2 bcdef
Lloron 2015	15.2 f	87.2 ab	9.5 hi	3.2 def
Navajita 2013	14.50 f	89.00 ab	8.50 hi	2.50 f
Pega ropa 2014	18.50 ef	91.75 a	5.25 i	3.00 ef
Plumilla 2013	36.25 bc	79.25 bc	18.25 fgh	2.50 f
Popotillo plateado 2013	16.50 f	38.50 f	52.00 c	9.50 ab
Punta blanca 2013	72.25 a	65.75 de	28.75 def	5.50 abcdef
Punta blanca 2014	14.0 fg	54.50 e	36.50 d	9.00 abc
Media	24.86	63.36	31.07	5.55
DMS	13.26	11.26	10.60	5.36

Means with the same vertical letter are statistically the same (Tukey, $\alpha = 0.05$), PG1 = percentage of germination at the first count at 7 days; PG2 = Final germination percentage 28 days.

Regarding SM, significant differences were found (Table 4), where the Popotillo plateado genotype showed the highest value and the lowest percentage is shown by the Plumilla genotype. The causes of low germination according to FAO (1985) may be: old seeds, unfavorable conditions for germination, damaged seed, hard seed and contamination. As for SD, there are significant differences (Table 4), where the highest percentage of hard seed is presented by the Banderita genotype, and with the lowest result, the Pega Ropa genotype. Bond *et al*. (1999) suggest that the ability of seeds to emerge and germinate through different soil depths should be taken into account; small seeds lack the hydraulic capacity to germinate and emerge. Poor seed quality is always a poor investment and, in the long run, may be much more expensive than the higher-priced seeds of known purity and germination (McILROY, 1973). The factors affecting germination and vigor are age, storage conditions, diseases, latent period, hard and abnormal seeds. There are other factors that can affect seed quality standards such as those mentioned by Bertín (2009) when using different doses of nitrogen, who observed that the physical purity of the seed is increased with nitrogen fertilization.

CONCLUSION

Under laboratory conditions, the evaluation of the seeds of the studied genotypes showed variability in seed quality among genotypes. The genotypes with higher quality with respect to the purity were Alcalino, Banderita, Briza, Pega Ropa and Punta Blanca and that could be object of certification. The genotypes with the highest percentage of germination in the second and final count were Pega ropa, Navajita and Llorón, and that could be subject to certification. A direct relationship between the percentage of purity and germination, as well as percentage of moisture and germination is shown.

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