Original Research Article

ADHERING AGENTS IN MAIZE SEED PELLETIZING

ABSTRACT

The mayze very important role in the Brazilian economy because it has a high commercial value, having great production due to its ability to adapt to different edaphoclimatic conditions. Family farming produces seeds from local varieties, called creole seeds. This type of seed is resistant because it keeps relevant characteristics left as an inheritance from its ancestors, who, free of charge, performed an environmental service for the preservation and perpetuation of this genetic heritage. Therefore, the work had to evaluate the effect of the adherent agents palm extract, aloe vera extract and sugar solution in the pelleting of creole corn seeds with rock dust. The work was carried out in the Plant Propagation Laboratory belonging to the Campus of Engineering and Agricultural Sciences of the Federal University of Alagoas. As adherent agents were used: water, palm extract, aloe vera extract and sugar solution. Rock dust (MB-4) was used for the coating. The evaluated parameters were: water content, weight of a thousand seeds, first germination count, germination, germination speed index, average germination time, germination uncertainty, length and dry mass of the root and aerial part. Palm extract is the most efficient adherent agent for pelletizing corn seeds with rock dust.

Keywords: Physiological potential, Local varieties, Zea mays L.

1. INTRODUCTION

The maize very important role in the Brazilian economy because it has a high commercial value, having great production due to its ability to adapt to different edaphoclimatic conditions. Family farming produces seeds from local varieties, called creole seeds. This type of seed is resistant because it keeps relevant characteristics left as an inheritance from its ancestors, who, free of charge, performed an environmental service for the preservation and perpetuation of this genetic heritage [1,2].

"Over the years, pelletizing has become a growing and prosperous technology, as it adds value to the seeds and contributes to an increasingly rigorous and competitive market. In addition, it helps in solving questions related to the size and shape of seeds, since it standardizes the size and shape, providing greater precision in planting" [3].

It is based on the application of a dry, inert, fine-grained material and a cementing material, also called adhesive or adherent, to the surface of the seeds.

According to [4] native varieties are important materials for genetic improvement, due to the high adaptation potential they present in specific environmental conditions and, as they constitute a source of genetic variability, they can be explored in the search for genes that are tolerant and/or resistant to biotic and abiotic factors. "Adhesive agents must have affinity with the other ingredients; be readily soluble in water; act in low concentration; become dry and non-sticky when dehydrated; form a low viscosity solution when rehydrated and; not be hygroscopic, corrosive or toxic" [5]

Rock dust can be seen as a non-adherent alternative for seed treatment, this material exhibits the characteristics of multielement composition and slow solubilization, that are suitable for use in alternative production systems and in highly favorable conditions for the leaching of nutrients, mainly in degraded tropical soils. Most rock dust does not affect the agroecosystem and, consequently, can contribute to improving the productive qualities of the soil [6].

Thus, the objective of this work was to evaluate the effect of the adherent agents palm extract, aloe vera extract and sugar solution in the pelleting of creole maize seeds with rock powder.

2. MATERIAL AND METHODS

Localization

The work was carried out at the Plant Propagation Laboratory, at the Campus of Engineering and Agricultural Sciences (CECA), at the Federal University of Alagoas (UFAL), Rio Largo, AL, Brazil. The seeds used were from the Jabotão maize cultivar (2019 harvest).

Procedures

As cementing agents were used: 1 - water, 2 - palm extract, 3 - aloe vera extract and 4 - sugar solution. The seeds were placed inside a plastic bottle where the cementing agent was added, being slightly shaken for uniform coating. For the coating, these were covered with the cementing agent and placed in a plastic tray containing rock powder (MB-4), the tray being lightly shaken until the seeds were perfectly covered. At the end of the process, excess rock dust was removed by sieving and the thousand seed weight (PMS) and water content were measured to quantify possible changes after treatment.

Subsequently, the treated seeds were placed to germinate on paper towels in the form of a roll, moistened with distilled water in an amount equivalent to 2.5 times their weight, then placed in a B.O.D. (Biochemical Oxygen Demand) at a temperature of 30 °C. "Seeds that originated normal seedlings, with all their essential structures, were considered germinated, thus showing the potential to continue their development and produce normal plants, when developed under favorable conditions" [7]. The daily counts of germinated seeds were carried out at the same time, for seven days.

Water Content and Thousand Seed Weight

To determine the water content of the seeds, the oven method was used at 105 ± 3 ºC for 24 hours, as prescribed in the Rules for Seed Analysis [7]. This determination was carried out when the tests were installed, using four samples per treatment. In this step, the weight of a thousand seeds was also determined by weighing eight repetitions of 100 units, according to the RAS [7]: PMS = PA x 100/N, where PMS = Weight of a thousand seeds (g); PA = Sample weight (g); N = Total number of seeds.

Analyze the variables

Germination: gi = (Σki=1ni/N) x 100, where ni is the number of germinated seeds/seedlings emerged in time i and N is the total number of seeds placed to germinate (Figure 1) [8].

Source: Author

Figure 1. Germitest paper with maize seeds.

First germination count: It was carried out jointly with the germination test, computing the percentage of normal seedlings obtained from the fourth day after the installation of the tests.

Germination Speed Index: G1/N1 + G2/N2 + ... + Gn/Nn, where IVG = G1, G2 and Gn = number of germinated seeds computed in the first, second and last count and N1, N2 and Nn = number of days from sowing to the first, second and last count [9].

Average germination time: Σ=1(niti)/Σ=1ni, where ti: time from the beginning of the experiment to the i nth observation (days or hours); ni: number of seeds germinated in time i (number corresponding to the i nth observation); k: last day of germination.

Uncertainty index: $U = -\sum_{i=1}^{k} F_i \log_2 F_i$ ≍ $F_i = n_i / \sum_{i=1}^{k} n_i$, where Fi: relative frequency of germination; ni: number of seeds germinated in time i (number corresponding to the i nth observation); k: last day of germination.
Length of the root and aerial part of the seedlings: "At the end of the germination test, the hypocotyl and the primary root of the normal seedlings of each subsample were measured with the aid of a graduated ruler and the results expressed in centimeters per seedling" [10].
Dry mass of the root and aerial part of the seedlings: "After the end of the germination test, the normal seedlings of each repetition were separated into aerial part and root and packed in paper bags, then placed in a forced ventilation oven at 80 ºC, for a period of 24 hours. After this time, the samples were placed in desiccators with activated silica gel and weighed on an analytical balance with a precision of 0.0001g, and the result expressed in g/seedlings" [11].
Statistical analysis: The experimental design used was completely randomized (DIC), with four replications of 25 seeds per treatment. Data were submitted to analysis of variance (ANOVA) and means compared by Tukey test and, when necessary, Dunnett test at 5% probability. Analyzes were performed using the SISVAR 5.6 software [12].

3. RESULTS AND DISCUSSION

From the results of the analysis referring to the weight of a thousand seeds (PMS) (Table 1) it was observed that the coating with the proposed adherent agents provided increments in the PMS in all treatments, except in the seeds that had water as an adherent. For the water content (TA) (Table 1) the seeds obtained similar results, not statistically different from each other. This means that the adherent agents used in the coating did not retain moisture and that the temperature of 35 °C (laboratory environment) was sufficient for drying during the coating process.

Table 1. Weight of a thousand seeds (WTS) and Water content (WC) of Creole maize seeds (Jabotão) subjected to adherent agents for pelleting with rock dust.

Treatments	WTS (g)	WC (%)
Water	299,0 bz	12,0 az
Aloe vera	324,1 ay	11,5 az
Palm	321,1 ay	11,9 az
Sugar solution	320,1 ay	11,1 az
	PMS = 298 z	TA = 12 z
CV (%)	10,98	9,25

Means followed by the same lowercase letter in the column do not differ at 5% probability by Tukey's test.
Means followed by the same letter (z, y), between WTS and WC (control - no bonding agents + rock dust), do not differ significantly at 5% probability by Dunnett's test.

As for the physiological characteristics, it was observed that in the first germination count (FGC), germination (GE) and germination speed index (GSI) there was no statistical difference between treatments (Table 2). These results are in agreement with [13], who also found that the percentage of seed germination is not reduced by pelleting, regardless of the material used, thus being a good indication in the execution of the process.

The same was observed by [14]for pearl millet seeds covered with different adherent materials. [15] studying super sweet corn seeds, reported that the coating provides homogeneity in shape and size, without compromising germination, a fact that occurred in the present study.

Table 2. First germination count (FGC), germination (GE) and germination speed index (GSI) of Creole maize seeds (Jabotão) submitted to adherent agents for pelleting with rock dust.

Treatments	FGC(%)	GE (%)	GSI
Water	99 a	99 a	6,187 a
Aloe vera	98 a	99 a	6,175 a
Palm	98 a	99 a	6,125 a
Sugar solution	92 a	92 a	6,000 a
CV (%)	2,44	5,98	2,97

Means followed by the same lowercase letter in the column do not differ at 5% probability by Tukey's test.

During the experiment, it was possible to verify that the coating with water (adhesive material) + rock dust easily disintegrated when in contact with the germitest paper. Therefore, the barrier imposed by the coating with this material was quickly dismantled and, as a result, gas exchange and water absorption by these seeds were easier compared to seeds coated with the aid of other adhesive agents.

The analysis of the results of mean time (Mt) and uncertainty (U) of germination of Creole seeds maize (Jabotão) (Table 3) confirmed that the cactus was significantly superior to the other treatments. Some delay in radicle emission may occur due to the material used in the coating process, which imposes a physical barrier that must be overcome by the seed. However, some materials allow a better diffusion of gases and water between the seed and the external environment [16], as was the case with the palm extract that obtained the lowest MT. Contrary to what is expected when interpreting GSI data, the best MT is related to the lowest values found for this variable.

Table 3. Mean time (MT) and uncertainty (I) of germination of Creole maize seeds (Jabotão) submitted to adherent agents for pelleting with rock dust.

Treatments	MT (days)	U (bit)
Water	4,34 b	0,162 b
Aloe vera	4,20 b	0,786 d
Palm	4,10 a	0,144 a
Sugar solution	6,00 b	0,349 c
CV (%)	5,65	10,11

Means followed by the same lowercase letter in the column do not differ at 5% probability by Tukey's test.

As for the initial development of the seedlings, evaluated by the length and dry mass of the primary root and shoot (Table 4), it was observed that the highest averages were reached when used in palm, differing statistically from the other treatments. The use of the above-mentioned adherent agent for pelleting probably favored the germination process with a more efficient degradation of the reserves present in the seeds, which ended up favoring the development of rootlets and shoots, and consequently the accumulation of dry mass, since at this stage, all seedling development is due to the chemical composition of the seeds [17].

Table 4. Root length (COM) to aerial part (COMPRA) of seedlings derived from Creole maize seeds (Jabotão) subjected to adherent agents for pelleting with rock dust.

Tratamentos	COMR (cm)	COMPA (cm)	MSR (g)	MSPA (g)
Water	9,60 b	8,37 b	0,817 b	1,048 b
Aloe vera	10,67 b	8,80 b	0,831 b	0,969 b
Palm	11,85 a	9,62 a	1,277 a	1,343 a
Sugar solution	7,20 c	7,00 c	0,095 c	0,078 c
CV (%)	7,66	5,85	5,62	4,28

Means followed by the same lowercase letter in the column do not differ at 5% probability by Tukey's test.

4. CONCLUSION

The study evaluated the effect of the adherent agents palm extract, aloe vera extract and sugar solution in the pelleting of creole maize seeds with rock powder. Based on the findings, it can be concluded that Palm extract is the most efficient adherent agent for pelletizing maize seeds with rock dust.

REFERENCES

1. Silveira DC, Bonetti LP, Tragnago JL, Neto N, Monteiro V. Agromophological characterization of Creole maize varieties (Zea mays L.) in the northwest region of Rio Grande do Sul. Science and Technology, v.1, n.1, p 01-11, 2015.

2. Melo LDFA, Melo Junior JLA, Santos EL, Soares LBF, Paes RA, Chaves LFG, Costa JFO, Assis WO. Physiological potential of creole maize seeds subjected to water and saline stress. Brazilian Journal of Development, v.6, n.5, p. 32076-32086, 2020. 10.34117/bjdv6n5-599.

3. Santos SRG. Pelleting Forest Seeds in Brazil: An Update. Forest and Environment. v. 23, no. 2, p. 286-294, 2016. doi.org/10.1590/2179-8087.120414.

4. Crisostomo, N.M.S.; Costa, E.A.; Silva, C. L.; Berto, T.S.; Ramos, M.G.C.; Melo Junior, J. L. A.; Melo, L. D. F. A.; Araujo Neto, J. C. Physiological quality of creole maize seeds from different locations. Craibeiras Journal of Agroecology, v. 3, no. 1, p. 6555-6560, 2018.

5. Nascimento, W. M.; Silva, J.B.C.; Santos, P.E.C.; Carmona, R. Germination of carrot seeds osmotically conditioned and pelleted with different ingredients. Brazilian Horticulture, no. 27, no. 1, p. 12-16, 2009. doi.org/10.1590/S0102-05362009000100003.

6. Van Straaten P. Farming with rocks and minerals: challenges and opportunities. Annals of the Brazilian Academy of Sciences, v. 78, no. 4, p. 731-747. Taken from Space & Geography, v. 9, no. 2, p. 179-193, 2009. dx.doi.org/10.1590/S0001-37652006000400009.

7. Brazil. Rules for Seed Analysis. Ministry of Agriculture and Agrarian Reform. SNDA/DNPV/CLAV, 2009. Brasília. 365 p.

8. Carvalho MP, Santana DG, Ranal MA. Seedling emergence of Anacardium humile A. St.-Hil. (Anacardiaceae) evaluated using small samples. Brazilian Journal of Botany, São Paulo, v. 28, no. 3, p. 627-633, 2005.

9. Maguire JD. Speed of germination: aid in selection and evaluating for seedling emergence and vigor. Crop Science, v.2, n.1, p.176-177, 1962.

10. Melo LDAF. Physiological potential of Enterolobium contortisiliquum (vell) seeds. Morong. 2011. 34 f. Monograph (Agronomy Course) - Federal Rural University of Pernambuco, Garanhuns, PE, 2011.

11. Nakagawa J. Vigor tests based on seedling performance. In: Krzyzanowski, F.C.; Vieira, R.D.; França, N.J.B. (Eds.). Seed vigor: concepts and tests. Londrina: ABRATES, 1999. p.2.1-2.24.

12. Ferreira DF. Sisvar: a computer statistical analysis system. Science and Agrotechnology, Lavras, v. 35, no. 6, p. 1039-1042, 2011.

13. Conceição PM, Vieira HD. Physiological quality and coating strength of maize seeds. Brazilian Seed Magazine, v. 30, no. 1, p. 48-53, 2008. doi.org/10.1590/S0101-31222008000300007.

14. Peske FB, November ADLC. Pearl millet seed pelleting. Brazilian Seed Magazine, v. 33, no. 1, p. 352-362, 2011. 10.1590/S0101-31222011000200018.

15. Mendonça EAF, Carvalho NM, Ramos NP. Coating of super sweet corn seeds (SH2). Brazilian Seed Magazine, v. 29, no. 2, p.68-79, 2007. doi.org/10.1590/S0101-31222007000200010.

16. Nascimento, W.M.; Silva, J.B.C.; Santos, P.E.C.; Carmona, R. Germination of carrot seeds osmotically conditioned and pelleted with different ingredients. Brazilian Horticulture, no. 27, no. 1, p. 12-16, 2009. doi.org/10.1590/S0102-05362009000100003.

17. Carvalho NM, Nakagawa J. Seeds: science, technology and production. 5.ed. Jaboticabal: FUNEP, 2012. 590p.