Plantability and moisture content of naked and pelleted seeds of supersweet (Sh_2) corn during cold storage conditions[1]

André de Oliveira Lagôa[2], Adriano César Ferreira[2], Roberval Daiton Vieira[2]*

ABSTRACT – The supersweet (Sh_2) corn seeds have a thin tegument and an irregular shape, which hinder the sowing procedure. As a function of those factors, the significance of using the pelleting process to improve sowing and standardize the stand of plants in the field without the need of thinning within the row is emphasized. Although this technique has already been known for many years, little has been studied on the effect of such procedure on the plantability and on the moisture content of the supersweet corn seeds. Therefore, this research work aimed at evaluating the effects of pelleting on the moisture content of the seeds along the storing process, on the occurrence of gaps on seed deposition and on the dropping of double seeds, with the aid of a testing seeder. Other physical attributes of seeds and pellets were also evaluated through tests of fragmentation, screen retention, mass of a thousand seeds and apparent volume. Results have shown an increase on the mass and on the volume of the pelleted seeds that presented highly resistance to cracks and breaking. The pelleting was efficient on the reduction of gaps and on the deposition of double seeds at sowing, thus providing highly satisfactory results for these attributes. An increase on the seed moisture content was also observed as a function of storage with a significant reduction on this factor after the pelleting procedure. Results allow concluding that the pelleting process reduces seed moisture content and improves plantability, positively affecting the efficiency of the sowing process.

Index terms: *Zea mays*, seed covering, physical quality, pellets.

Plantabilidade e teor de água durante o armazenamento em câmara fria de sementes de milho superdoce (Sh_2) peletizadas

RESUMO - As sementes de milho superdoce (Sh_2) possuem tegumento fino e formato irregular, dificultando a operação de semeadura. Em função disso, surge a possibilidade de utilizar o processo de peletização para facilitar a semeadura e obter estande uniforme sem a necessidade de raleio de plantas. Embora essa técnica seja conhecida há muitos anos, pouco se estudou sobre o efeito desse procedimento na plantabilidade e no teor de água de sementes de milho superdoce. Deste modo, este trabalho teve como objetivo avaliar o efeito da peletização no teor de água ao longo do armazenamento e na ocorrência de falhas e de sementes duplas em semeadora de provas. Foram avaliados também outros atributos físicos das sementes e dos péletes por meio dos testes de fragmentação, retenção de peneiras, massa de mil sementes e volume aparente. Os resultados mostram aumento no massa e no volume das sementes peletizadas, que se mostraram muito resistentes à formação de trincas e quebras. O revestimento foi eficiente na redução das falhas e ocorrência de sementes duplas, proporcionando resultados altamente satisfatórios para esses atributos. Foi observado também aumento do teor de água em função do armazenamento e redução do mesmo após o revestimento. Os resultados permitiram concluir que o revestimento reduz o teor de água das sementes e melhora a plantabilidade das mesmas, afetando positivamente a eficiência do processo de semeadura.

Termos para indexação: *Zea mays*, recobrimento, qualidade física, péletes.

[1]Submitted on 02/11/2011. Accepted for publication on 08/02/2011

[2]UNESP/FCAV, 14884-900 - Jaboticabal, SP, Brasil.

*Corresponding author < rdvieira@fcav.unesp.br>

Introduction

Little known in Brazil, the sweet corn is very popular in Europe, United States, and Canada, where it is traditionally consumed "*in natura*". Nowadays, the worldwide area cultivated with that crop reaches 900 thousand hectares. In Brazil, only 36 thousand hectares are cultivates with sweet corn, with practically 100% of production being directed to industrial processing (Barbieri et al., 2005).

The sweet corn differentiates from the other types of grain corn by its natural sweet flavor, which is resultant of genetic mutations that block the conversion of sugars into starch during the grain development and maturation processes. In addition, the sweet corn presents high nutritive value and organoleptic characteristics such as flavor, softness and texture that favor yet more its consumption "*in natura*" or its use in dishes as puddings, pies, and ice creams.

The industry has preference by the high content of sugar and low content of starch, which are also desirable for the "*in natura*" consumption. From another stand point, the higher sugar content of the grains impairs the preparation of some dishes such as sweet corn pudding and sweet corn custard, due to the its low starch content.

The mutation that favored the sweet corn consumption, both by industry and in cooking, also provoked alterations in the seed structure and composition, being the most visible one the wrinkling of the pericarp after maturity, when the seeds reach low levels of moisture content.

According to Styer and Cantliffe (1983), generally the sweet corn seeds are not uniform and are more subjected to damages than the common corn seeds, besides presenting a dysfunction in the scutellum in relation to the metabolism and to the use of carbohydrates.

The wrinkling impairs the sowing procedure of those seeds since the equipments available in the market are not sufficiently adequate to sow the non-uniform and lightweight sweet corn seeds. Even the vacuum seeders or suction seeders, whose working principle differs completely of the conventional seeders, are not able to solve the problems of gaps and the deposition of double seeds during the sowing procedure.

Thus, to obtain the desired plant stand in the field, many farmers sow quantities of seed per hectare above the amount recommended by the seed companies and then thinning the seedlings. Besides increasing expenses with seeds and labor for the thinning, such practice guarantees only the desired plant stand, without any effect on the distribution of plants in the field and consequently on the uniformity of the ears of corn, one of the most important factors for the canning industry.

To assure the good quality of the sweet corn seed lots, the seed producing companies perform the harvest during the Autumn/Winter period, thus avoiding the high temperatures and heavy rainfalls. The sowing demand for seeds, however, is distributed all year round aiming at meeting the needs of the processing sweet corn industry, what turns its storage into a necessity. This is the reason for studying the behavior of the moisture content of those seeds during storage, since some papers on that research line emphasize that the type of material used for seed coating and its moisture content are the main factors affecting seed longevity along time (Roos and Moore, 1975; Roos, 1979).

Within this context, this research work aimed at evaluating the effect of pelleting on the physical quality and on the plantability of the Supersweet sweet corn commercial seed lots.

Material and Methods

The research work was carried out in the Seed Analysis Laboratory of Syngenta Seeds Ltd., located in the municipality of Matão, State of São Paulo, Southeast Brazil. Ten lots of supersweet (Sh_2) corn (*Zea mays* L) were subjected to the pelleting process at the ALCOBERING Company, located in the municipality of Aparecida de Goiânia, State of Goiás, Central Brazil. Analyses of the seed physical quality were performed soon after pelleting and determinations of the moisture content of the Supersweet sweet corn seeds were carried out at three different times, with 90 days interval, between October 2009 and April 2010.

Seeds of two cultivars of simple hybrid of supersweet (Sh_2) corn, denominated Tropical Plus and RB 6324, obtained from 10 different commercial seeds lots were pelleted and divided into two groups, denominated naked and pelleted. The seven first seed lots were of the hybrid Tropical Plus and the remaining ones were of the hybrid RB 6324 (Table 1). Soon after the pelleting process, the different seed lots, pelleted or not, were evaluated in the laboratory and again after three and six months of storage. For evaluation, the seed lots were wrapped in permeable multilayered paper and stored into cold chambers, under conditions similar to those usually used in the supersweet sweet corn seed producing companies (between 10 ºC and 12 ºC; and RH between 55% and 60%), as recommend Camargo and Carvalho (2008).

Table 1. Seed lots, hybrids of supersweet (Sh_2) corn, and seed screens used in the experiment.

LOTS	HYBRIDS	SCREENS
1	Tropical Plus	18 C
2	Tropical Plus	18 C
3	Tropical Plus	18 C
4	Tropical Plus	16 C
5	Tropical Plus	16 C
6	Tropical Plus	16 C
7	Tropical Plus	16 C
8	RB 6324	20 C
9	RB 6324	16 C
10	RB 6324	16 R

Since there is no specific procedure for the analysis of pelleted seeds, the same methodology used to evaluate naked seeds was employed:

Moisture content (MC): this parameter was determined before and during the storage period on both naked and pelleted seeds. Two replications per treatment were performed through the oven method at 105 ± 3 ºC, for 24 h, using a gravitational convection oven (Brasil, 2009). Results were expressed in percentage. At the final step of the experiment, the moisture content of the naked seeds, pelleted seeds, peeled seeds (by manually removing the covering material), and of the covering material alone were also determined for each seed lot studied. It was also determined the moisture content of the pelleted seeds of each seed lot using an oven at 105 ± 3 ºC, for 48 h, to verify if the 24 h drying time was appropriate for determining the moisture content on the seeds.

Fragmentation (FR): similar to the work of Mendonça et al. (2007), a fragmentation test was performed on three replicates (50 pellets each), which were individually evaluated to verify the physical structure of the pellets, with the aid of a magnifying lens (10 X magnification). The evaluation was carried out by surveying the number of pellets presenting cracks or broken parts and the results were expressed in percentage of fragmented pellets.

Screen retention test (SR): the classification by screening, for all seed lots, was performed with the aid of round-hole screens with a diameter of 26/64” (equivalent to 10.3 mm), 24/64” (9.5 mm), 22/64” (8.7 mm), 20/64” (7.9 mm), 18/64” (7.1 mm) and 16/64” (6.4 mm) (henceforth denominated 26, 24, 22, 20, 18, and 16 screen, respectively) to verify the concentration of the seed mass at the nominal screen, as well as the alterations on the size of seeds after pelleting. Three seed samples (200 g each) were subjected to a set of hand screens. After the shaking of the set of screens for approximately 1 min., the seed mass retained on the nominal screen was determined and results were transformed into percentage. The same procedure was performed after pelleting (Brasil, 2009).

Mass of 1000 naked and pelleted seeds (MTS): the masses of the naked and pelleted seeds were determined in eight replications of 100 naked seeds and 100 pellets, according to the rules of the Sistema Nacional de Sementes e Mudas – SNSM (National System of Seeds and Transplanted Seedlings) (Brasil, 2009). Results were expressed in grams (g) of the mean mass of 1000 seeds and 1000 pellets. The norms established by the Regras para Análise de sementes (Rules for Seed Analysis) (Brasil, 2009) were applied for determining the masses of 1000 seeds and 1000 pellets.

Apparent volume (AV): with the aid of a 1000 mL measuring cylinder, the apparent volume of seeds was determined. In that cylinder, 1000 mL of naked and pelleted seeds were measured and then weighed in a precision scale, using two decimals. Three replications were performed and the results were expressed in grams per liter ($g.L^{-1}$).

Plantability (PT): an experimental disk seeder, equipped with an electronic “CornCounter”® sensor simulating a 4.5 $km.h^{-1}$ sowing speed procedure was used to perform this test. Since there is no specific seeding disks for naked or pelleted seeds for this type of corn hybrid, disks of the brands “Apolo” and “Socidisco” (with semi-lowered and lowered smooth rings) were used for each lot of naked and pelleted seeds, to identify the best combination of disk and ring in relation to the occurrence of gaps and dropping of double seeds within the furrow during the sowing procedure. The “CornCounter”® is an equipment jointly developed by the enterprises Syneltro and Syngenta. In the last enterprise, such equipment is used in all commercialized seed lots to determine the number of gaps (when no seed passes trough the disk orifice) or deposition of double seeds (when two seeds pass through one single disk orifice at the same time). This is a simulation of the sowing procedure in which the seeds distribution is graphically visualized under laboratory conditions. For each sample of 2000 seeds, the number of gaps and the dropping of double seeds were determined, generating a graphically statistical visualization of those characteristics. Three replications were performed and the results were expressed in percent gaps and double seeds, according to methodology developed by the Syngenta enterprise.

Data were submitted to ANOVA and means were compared by the Tukey test at 5% probability. The AgroEstat program, developed by the Department of Exact Sciences of the Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP) (Sao Paulo State University "Júlio de Mesquita Filho – UNESP), Jaboticabal Campus, was used for data computation.

Results and Discussion

The pelleting process implies in the application of a relatively high volume of H_2O, used as a vehicle for spraying the coating materials suspension on the seeds (Silva et al., 2002). This process of hydration is considered acceptable from the technical-scientific point of view (Caseiro and Marcos-Filho, 2005). Results presented on Table 2, however, show lower moisture contents in the pelleted seed as compared to naked seeds. Mendonça et al. (2007) and Conceição et al. (2009) achieved similar results and attributed the reduction of moisture content in the pelleted seeds to the increase of the total dry weight what resulted in the apparent reduction of moisture content of the pellets.

Table 2. Initial moisture content (%) of naked and pelleted seeds of supersweet (Sh_2) corn and mean values of 10 seed lots, considering the storage periods.

Lots	% in naked seeds	% in pelleted seeds
1	10.3	7.5
2	10.2	7.4
3	10.2	7.4
4	10.2	6.9
5	10.3	7.5
6	9.9	7.4
7	10.2	7.0
8	10.7	7.4
9	10.6	7.8
10	10.7	7.6
Initial moisture	10.0 ns*	7.2 ns*
90 days under cc**	10.3	7.4
180 days under cc**	10.6	7.6

* = statistically non significant; ** = days after storage under cold conditions.

As in Conceição et al. (2009), the origin of the low moisture content of pelletized seed was sought (Table 3). According to results, the naked seeds and those manually uncovered presented similar or higher moisture contents than the pelleted seeds and displayed exactly the same results independently of being maintained in the oven for 24 or 48 hours. The covering material alone, however, presented moisture content relatively lower, being attributed to it the responsibility for the lower moisture content of the pelleted seeds.

Table 3. Means moisture content (%) of 10 naked and pelleted seed lots of supersweet (Sh_2) corn and moisture content of the covering material that remained into a seed dryer for 24 and 48 hours and evaluated after 12 months of storage under cold chamber conditions.

Type of Seed samples	% moisture content
Naked seeds 24 h	9.9
Pelleted seeds 24 h	7.2
Pelleted seeds 48 h	7.2
Manually uncovered seeds 24 h (*)	10.2
Covering material alone (**)	6.3

(*) Samples obtained by manually removing the coating material.

(**) Manually removed from the pelleted seeds.

The naked seeds of the hybrid RB 6324 presented moisture content greater than those of the hybrid Tropical Plus (Table 2). That fact could have happened as a function of the drying process, where different samples are placed into distinct chambers or dryers remaining there until reaching the desired moisture content, which may vary within the established temperature range, determined in function of the manual sampling performed inside the dryer.

These differences in the moisture content between the hybrids RB 6324 and Tropical Plus was not observed after the pelleting process. That may be due to the degree of hydration that these seeds underwent what, during the process, may have approximated their moisture contents. Such information was obtained from the evaluation of the moisture content per seed lot of the uncovered sweet corn seeds (data not presented).

Even with variation on the size of seeds (screens 16, 18, and 20), there was no effect of seed lot on the initial moisture content of the supersweet (Sh_2) corn naked or pelleted seeds (Table 2). Oliveira et al. (2003) obtained similar results with tomato (*Lycopersicon esculentum* L) pelleted seeds.

When analyzed separately, the results of the naked and pelleted seeds showed that a slight increase on moisture content indeed occurred during storage (Table 2), which may be attributed to the combination of temperature (10 ºC) and RH (55% to 60%) in the cold chamber. Those differences, however, were not statistically significant.

Results of the fragmentation test (Table 4) show a low percentage of cracked or broken seeds (2% to 13.3%) as compared to results obtained by Mendonça et al. (2007) (34% to 90%) demonstrating the good quality of the material used for covering the seeds. The best result was displayed for the seed lot number 7 (screen 16 C of the hybrid Tropical), which differed from seed lots 4, 6, and 8 that had greater number of cracked or broken seeds.

The best results for the screen retention test were obtained with the seed lots 1, 2, 3, and 8. These results differed from lot 10, which presented the worst result (87.3%). As pelleted seeds are concerned, the lots 1, 2, 4, 6 and 7 presented screen retention significantly higher than the remaining seed lots, also showing the effect of the lot for this parameter (Table 5).

Table 4. Percent cracked or broken seeds (C&B) obtained in the fragmentation test of pelleted seeds and mass (g) of 1000 naked and pelleted seeds (MTS) of 10 seed lots of supersweet (Sh_2) corn.

Seed lots	C&B (%)	MTS (g)	
		Naked seeds	Pelleted seeds
1	9.3 ab	105.0 cB	341.3 eA
2	4.7 ab	106.9 cB	345.0 eA
3	4.0 ab	106.9 cB	412.5 bA
4	13.3 a	88.8 dB	290.0 hA
5	12.0 ab	91.3 dB	341.3 eA
6	12.7 a	88.8 dB	303.1 gA
7	2.0 b	90.0 dB	310.6 fA
8	13.3 a	123.1 aB	496.3 aA
9	5.3 ab	108.1 cB	391.9 cA
10	10.7 ab	118.8 bB	351.3 dA
Means	8.7	102.8	358.3
CV (%)	41.8	1.1	

*Means followed by the same lowercase letters in the columns and uppercase letters in the lines do not statistically differ from each other by the Tukey test at 5% probability.

Table 5. Percent screen retention (SR) and apparent volume (AV) of 10 seed lots de of naked and pelleted supersweet (Sh_2) corn seed.

Seed lots	SR (%)		AV (g/L)	
	Naked seeds	Pelleted seeds	Naked seeds	Pelleted seeds
1	93.0 aA*	66.6 aB*	466.5 abB*	669.0 aA*
2	93.6 aA	65.5 aB	467.2 aB	634.0 cA
3	93.0 aA	49.8 cB	467.3 aB	614.7 fA
4	89.7 abA	68.1 aB	461.2 bcB	614.7 fA
5	90. 8 abA	53.5 bcB	458.0 cdB	621.8 deA
6	90.7 abA	67.6 aB	453.7 deB	618.5 efA
7	90.3 abA	67.8 aB	451.5 eB	642.5 bA
8	91.0 aA	53.8 bcB	435.0 fB	627.0 dA
9	91.4 abA	54.3 bB	470.0 aB	639.7 bA
10	87.3 bA	56.4 bB	464.5 abB	608.3 gA

*Means followed by the same lowercase letters in the columns and uppercase letters in the lines do not statistically differ from each other by the Tukey test at 5% probability.

The standard for seed production and commercialization for hybrid corn determines the minimum screen retention of 94% (Brasil, 2004). The same decree, however, reduces that standard for cultivars of popcorn, sweet corn and for the supersweet (Sh_2) corn group in function of the difficulties in the separation of those seeds through screens.

Similarly to the results obtained by Catão et al. (2010), who worked with naked seeds of the popcorn cultivars "Tupiniquim" and "Pipoqueiro Vinhedo", no seed lot studied reached the standard of 94% before or after the pelleting process (Table 5). Working with 15 cultivars of common corn, the same authors obtained 100% of samples within the standard for screen retention, showing the difference in classifying corn seeds with different types of endosperm. As related to pelleting process, all naked seeds lots presented figures for screen retention greater than the pelleted ones, emphasizing the negative effect of pelleting on the screen retention parameter. According to Schuch and Peske (2008), the uniformity in size and shape of corn seeds provide for a smaller number of gaps and dropping of double seeds in the sowing furrow, thus improving their plantability. Seed pelleting may not always contribute for the uniformity of the seed lot, considering the screen retention parameter. To solve that uniformity problem there is the possibility of screening the pellets after dehydration, uniforming them by shape and size and thus eliminating that inconvenience of the pelleting process.

Seed weight is a physical characteristic that many times can influence its germination performance, being some times used as a classification characteristic for seed lots. Results on the mass of 1000 naked or pelleted seeds had shown that the covering employed triplicated the volume of the propagation units, now denominated pellets, for all seed lots analyzed (Table 4). According to Carvalho et al. (1993), seed pelleting provides for a significant increase of inert material on the seed surface, increasing its size but proportionally decreasing its quantity in relation to the total mass of the pellets.

As expected, in a general way the small seeds presented smaller mass than the large ones before and after pelleting (an effect observed for the seed lots 4, 6, and 7 on screen 16 C) and the large seeds displayed a greater mass (an effect observed for the seed lot 8 on screen 20 C). These results corroborates those of Carvalho et al. (1993) that affirm that the separation by width has show statistically significant differences among the fractions, indicating a trend on the reduction of seed mass with the reduction in size. Although seed pelleting plays an important role on aerial sowing, by improving the ballistic projection of seeds, the increase in the mass of 1000 seeds for the majority of species, including sweet corn, does not bring any benefit (Scott, 1989).

Oppositely to results of Carvalho et al. (1993) that observed an inversely proportional correlation between the screen classification and the density of sweet corn seeds, the results herein achieved do not allow such correlation. The three higher figures for that parameter were displayed for the seed lots 9 (screen 16 C) 3, and 2 (screen 18 C) that statistically differed from seed lots 4, 5, 6, and 7 (screen 16 C) and 8 (screen 20 C) (Table 5).

Results on the apparent volume had a mean increase of 37% in the pelleted seed mass in relation to the naked seeds of sweet corn, indicating that the coating material possesses higher density. These data were similar to those of Mendonça et al. (2007) that in an analogous manner determined the apparent seed volume and verified that 300 g of naked seeds occupied an apparent volume 34% greater than the pelleted seeds.

Considering the trend in commercializing seeds by numerical quantity, the increase in the volume of covered seeds would demand higher capacity packages or a greater number of packs for the same number of seeds. Besides, by occupying more space, a greater number of stops for reloading the seeder would be necessary, thus reducing the performance of the sowing procedure.

The distribution of plants within the cultivated area is as important as the use of improved cultivars, the selection of high quality seeds and the use of adequate management practices. The best plant arrangement along the row is that in which the plants stay exactly equidistant from each other within the sown line. Those conditions provide a lower competition degree among them (Schuch and Peske, 2008).

Dias et al. (2010) demonstrated that the increase in the productivity on corn is directly correlated to the maximization of the environment exploration by the plant, which occurs more effectively when uniformity among plants distribution within the field exists.

Observing the results of the plantability test, it can be noticed that the seed lot number 9, before pelleting, displays the worst value for the number of double seeds (19.1%). Oppositely, the same seed lot, jointly with seed lot 10, presented the best results in the percent gaps in the sowing line. That fact was already expected since it is very common that different seed lots present antagonistic values for the gaps and dropping of double seeds parameters.

According to Schuch and Peske (2008), the occurrence of two plants together has the over seeding as the least inconvenient, since the yield of the two plants together is practically equal to the yield of a plant correctly spaced from the other plants. Thus, considering the low productive plasticity of the corn crop, the presence of gaps is much more prejudicial and undesirable than the occurrence of double seeds. In function of this fact the seed industry opts by the indication of seeder disks that are able to provide the lowest possible number of gaps at the sowing procedure, even though favoring the occurrence of double seeds.

Despite the relative worsening of the pelleted seeds behavior in relation to the naked seeds in the screen retention, mass of 1000 seeds and apparent volume tests, the plantability test (which is the most important, since simulates the sowing procedure) the results herein obtained were highly satisfactory. All seed lots presented a statistically significant improvement after the pelleting process for both parameters: occurrence of seed gaps or dropping of double seeds (Table 6). The general mean of double seeds, which before pelleting was 14.7%, decreased to 1.5% after pelleting. Even the worst results obtained after pelleting (found for the seed lots 8, 9, and 10 that in average presented 2.6% of double seeds) were lower than those attained for naked seeds. It is worth to emphasize that for the screen retention test the possibility of sieving the pellets after the coating exists, thus improving yet more their uniformity.

Table 6. Evaluation of plantability of naked and pelleted seeds of supersweet (Sh_2) corn through the test of simulation of the occurrence of the dropping of double seeds and gaps on seeds dropping during the sowing procedure.

Seed lots	Double seeds		Seed gaps	
	Naked	Pelleted	Naked	Pelleted
1	10.7 gA	1.5 abcB	7.9 aA	0.2 aB
2	16.5 bA	1.3 bcB	5.2 cA	0.3 aB
3	16.0 bcA	1.0 bcB	5.2 cA	0.7 aB
4	15.5 bcdA	1.0 bcB	6.1 bcA	0.1 aB
5	13.8 deA	0.9 bcB	6.2 bcA	0.3 aB
6	14.3 cdeA	0.5 cB	5.5 cA	0.1 aB
7	13.1 efA	0.5 cB	7.0 abA	0.1 aB
8	15.7 bcA	3.2 aB	7.0 abA	0.5 aB
9	19.1 aA	2.2 abcB	3.8 dA	0.2 aB
10	11.9 fgA	2.5 abB	3.2 dA	1.2 aB
Means	14.7	1.5	5.7	0.4
CV (%)	8.2		14.0	

*Means followed by the same lowercase letters in the columns and uppercase letters in the lines do not statistically differ from each other by the Tukey test at 5% probability.

In relation to percent seed gaps (Table 6), the results obtained for pelleted seeds in relation to the naked seeds were yet more surprising and had shown an improvement up to 70 times higher for this parameter (seed lot 7). For all seed lots the general mean of seed gaps, which before coating was 5.7%, has lessened to 0.5%. Even the worst result (seed lot 10, with percent gaps equal to 1.2%), i.e. the worst result achieved for this parameter in the experiment, is perfectly acceptable from the technical viewpoint.

Mendonça et al. (2007) achieved similar results for distribution and number of seeds per linear meter. In their trials, the results obtained with pelleted supersweet sweet corn seeds were also better than those obtained with naked seeds. However, the authors also reported that during the plantability test, the fragile coating structures of some seed lots was destroyed and the dust resultant from the coating destruction impaired the fluidness of the seed mass during the sowing procedure; and that this phenomenon could be related to the low resistance of the pellets to fragmentation. Such problem was not observed in this research work, probably because the pellets herein used were highly resistant, therefore without producing dust.

Seed pelleting is an efficient alternative for the improvement of shape and uniformity of seeds, providing precision during the sowing procedure even with the use of mechanical seeders that are less expensive and of easier maintenance than the pneumatic seeders, whose use is also recommended for the sowing of pellets.

Conclusions

The pelleting is efficient on the reduction of seed gaps and on the occurrence of the deposition of double seeds, therefore improving the sowing process;

There is an increase in the seed moisture content in function of the storage under cold chamber conditions.

Acknowledgements

The authors would like to thank to Syngenta Seeds Ltda. for the financial support and for allowing the accomplishment of this research work; to the seed analyses technicians from Syngenta Seeds Ltda. of Matão Laboratory facilities for their aid with the laboratory tests; and to CNPq for the research productivity scholarship granted.

References

BARBIERI, V.H.B.; LUZ, J.M.Q.; BRITO, C.H.; DUARTE, J.M.; GOMES, L.S.; SANTANA, D.G. Produtividade e rendimento industrial de híbridos de milho-doce em função de espaçamento e populações de plantas. *Horticultura Brasileira,* v.23, n.3, p.826-830, 2005. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0102-05362005000300027&lng=pt&nrm=iso.

BRASIL. Decreto nº 5.153, de 23 de julho de 2004. Aprova o regulamento da Lei n.10711, de 5 de agosto de 2003, que dispõe sobre Sistema Nacional Sementes e Mudas- SNSM e dá outras providências. *Diário Oficial da Republica Federativa do Brasil*, Brasília, DF, 26 jul. 2004, Seção 1.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. *Regras para análise de sementes.* Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Brasília: MAPA/ACS, 2009. 395p. http://www.scielo.br/scieloOrg/php/reflinks.php? refpid=S0101-31222010000400008000003&pid=S0101-31222010000400008&lng=en

CAMARGO, R.; CARVALHO, M.L.M. Armazenamento a vácuo de semente de milho-doce. *Revista Brasileira de Sementes,* v.30, n.1, p.131-139, 2008. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101- 31222008000100017&lng=en&nrm=iso

CARVALHO, M.L.M.; BILIA, D.A.C.; SILVA, W.R.; MENEZES, J.R. Efeitos do beneficiamento na qualidade de sementes de milho infectadas por *Fusarium moniliforme* sheld. *Scientia Agricola,* v.50, n.2, p.295-302, 1993. <http://www.scielo.br/scielo.php? script=sci_arttext&pid=S0103-90161993000200018&lng=en&nrm=iso>.

CASEIRO, R.F.; MARCOS-FILHO, J. Métodos para a secagem de sementes de cebola submetidas ao condicionamento fisiológico. *Horticultura Brasileira,* v.23, n.4, p.887-892, 2005. http://www.scielo.br/pdf/hb/v23n4/a05v23n4.pdf

CATAO, H.C.R.M.; COSTA, F.M.; VALADARES, S.V.; DOURADO, E.R.; BRANDÃO JÚNIOR, D.S.; SALES, N.L.P. Qualidade física, fisiológica e sanitária de sementes de milho crioulo produzidas no norte de Minas Gerais. *Ciência Rural,* v.40, n.10, p.2060-2066, 2010. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-84782010001000002&lng=en&nrm=iso

CONCEICAO, P.M.; VIEIRA, H.D.; SILVA, R.F.; CAMPOS, S.C. Germinação e vigor de sementes de milho recobertas e viabilidade do inoculo durante o armazenamento. *Ciência e Agrotecnologia,* v.33, n.3, p.765-772, 2009. http://www.scielo.br/scielo.php? script=sci_arttext&pid=S1413-70542009000300015&lng=en&nrm=iso

DIAS, M.A.N.; MONDO, V.H.V.; CICERO, S.M. Vigor de sementes de milho associado à mato-competição. *Revista Brasileira de Sementes*, v.32, n.2, p.93-101, 2010. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-31222010000200011&lng=en&nrm=iso

MENDONÇA, E.A.F.; CARVALHO, N.M.; RAMOS, N.P. Revestimento de sementes de milho superdoce (sh2). *Revista Brasileira de Sementes,* v.29, n.2, p.68-79, 2007. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-31222007000200010&lng=en&nrm=iso

OLIVEIRA, J.A.; PEREIRA, C.E.; GUIMARÃES, R. M.; VIEIRA, A.R.; SILVA, J.B.C. Efeito de diferentes materiais de peletização na deterioração de sementes de tomate durante o armazenamento. *Revista Brasileira de Sementes,* v.25, n.2, p.20-27, 2003. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101- 31222003000400004&lng=en&nrm=iso

ROOS, E.E. Germination of pelleted and taped carrot and onion seed following storage. *Journal of Seed Technology*, v.4, n.1, p.65-78, 1979.

ROOS, E.E.; MOORE, D. Effect of seed coating on performance of lettuce seeds in greenhouse soil tests. *Journal of the American Society for Horticultural Science*, v.100, n.5, p.573-576, 1975.

SCOTT, J.M. Seed coatings and treatments and their effects on plant establishment. *Advances in Agronomy,* v.42, p.43-83, 1989. http://www.scielo.br/scieloOrg/php/reflinks.php? refpid=S0101-31222007000200010000024&pid=S0101-31222007000200010&lng=en

SCHUCH, L.O.B.; PESKE, S.T. Falhas e duplos na produtividade. *Seed News*, v.12, n.6, p.22-27, 2008. Capa. http://www.seednews.inf.br/portugues/seed126/artigocapa126.shtml

SILVA, J.B.C.; SANTOS, P.E.C.; NASCIMENTO, W.M. Desempenho de sementes peletizadas de alface em função do material cimentante e da temperatura de secagem dos péletes. *Horticultura Brasileira,* v.20, n.1, p.67-70, 2002. http://www.scielo.br/scielo.php? script=sci_arttext&pid=S0102-05362002000100013&lng=en&nrm=iso

STYER, R.C.; CANTLIFFE, D.J. Relationship between environment during seed development and seed vigor of two endosperm mutant of corn. *Journal of the American Society for Horticultural Science*, v.108, n.5, p.717-720, 1983. http://www.scielo.br/scieloOrg/php/reflinks.php?refpid=S0101-31222008000100017000028&pid=S0101-31222008000100017&lng=en