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Physiological quality of soybeans seeds treated with fungicide and coating with polymers

ABSTRACT

The objective of this study was to evaluate the effect of polymer coating and fungicide on seed quality of soybean cv. AG 7000 seed lots with high and low germination rates. The seed film coating was performed using two commercial brands of polymers, LABORSAN®, and LANXESS®, in doses of 2.0 and 3.5 ml for each kg, with and without mixture of the fungicide Carbendazim + Thiram (firewalk®). The seed quality evaluation was measured by the germination test, germination in sand, and accelerated aging. The use of polymers in soybean seeds provides seeds with good appearance and coloration and it can be applied to differentiate the seed from the commercial grain. The fungicide and the polymers do not affect the physiological quality of soybean seeds. The results of the polymer and fungicide are higher in the accelerated aging test, with the highest percentage of germination of soybean seeds in relation to the control.

Key words: *Glycine max* L. Merril, film coating, seed treatment

Qualidade fisiológica de sementes de soja tratadas com fungicida e recobertas com polímeros

RESUMO

O objetivo principal deste trabalho foi avaliar o efeito do recobrimento com polímeros e fungicida na qualidade de sementes de soja de alta e baixa germinação da cv. AG 7000. O revestimento foi realizado com duas marcas comerciais de polímeros, LABORSAN® e LANXESS® nas doses de 2,0 e 3,5 mL para cada kg de semente, com e sem mistura do fungicida Carbendazim + Thiram (firewalk®). A avaliação da qualidade das sementes foi realizada por meio do teste de germinação, germinação em substrato de areia e envelhecimento acelerado. O uso de polímeros na semente de soja proporciona sementes com boa aparência e coloração, podendo ser aplicado para diferenciar a semente do grão comercial. O fungicida e o polímero não prejudicam a qualidade fisiológica da semente de soja. Os resultados do polímero e fungicida são superiores no teste de envelhecimento acelerado, com maior percentual de germinação de sementes de soja em relação à testemunha.

Palavras-chave: *Glycine max* L. Merril., *film coating*, tratamento de semente

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Introduction

In Brazil, almost 100% of soybean seeds are treated with fungicides, 30% with insecticides and 50% with micronutrients and coating products (film coating) with a polymers base, which ensure a uniform coverage and adherence to the seeds. The goal is to protect the seeds and increase their performance in the field, both in initial establishment or during their growth cycle (Baudet & Peske, 2006).

Main purposes of seed coating are improvement of the physiological quality of seeds and crop yield (Sampaio & Sampaio, 1994). Polymers give additional protection to the seeds, acting against pathogens, ensuring greater safety during handling (Roban, 1994) and, combined with the fungicide treatment, they can increase the germination of tomato seeds for lots of low vigor, without affecting the action of the fungicide on the fungi (Lima et al., 2003). Considering the large number of factors and interactions involved in the technique of coating, it is necessary to maintain continuous and extensive studies on the use of polymers (Sampaio & Sampaio, 1994).

Despite the fact that seed coating technology has been used for some time, in seeds of vegetables and forest, for most major crops this technique is considered new and little known, mainly due to the market need for differentiating grain from seeds and allowing the aggregation of values (Baudet & Peres, 2004). The coating polymer is capable of providing improvement in the condition of sowing significantly. It also reduces agrochemical losses caused by the friction of the seeds in planters, distribution and adherence of the active ingredients on the surface of seeds and the risks to the operators.

Currently, to ensure adequate growth and development of crops providing good yields, the use of synthetic fungicides with polymers is one of the most recommended practices. Several studies have reported the efficiency of fungicides to control pathogens associated with wheat seeds (Marini et al. 2011) and, it is also efficient for the increase in field emergence (Rezende et al., 2003). The importance of seed health is related to the fact that approximately 90% of crops used for human and animal food are propagated by seeds (Henning, 2004) and the inoculum of pathogens present in seeds can result in the increase of disease in the field and their introduction in areas free of pathogens. Therefore, the objective of this study was to evaluate the effect of polymer coating and fungicide on seed quality of soybean cv. AG 7000 seed lots with high and low germination rates.

Material and Methods

The experiment was conducted at the Laboratory of Seed Analysis of Agrosilo Santa Catalina (Sementes Veronica), in Los Cedrales, Paraguay. Two lots of soybean seeds from company Nidera® (cv. AG 7000 RR) was used in the region of Mbarete - PY. The germination of two lots was of 92 and 54%, with water content of 11.3% and 11.8% respectively. For the coating of the seeds, the liquid formulations LABORSAN® Green Solid Brill and LEVANYL® Red ST – GR were used. They were used at doses of 2.0 and 3.5 mL per kg^{-1} of seeds.

The fungicides used were commercial product of systemic and contact, Firewalk® (Carbendazim 30 g.a.i/kg + thiram 70 g.a.i/kg in the absence of dye) the company Aktra®, toxicological class 3 at the recommended dose for the soybean crop of 2 mL of commercial product per 1 kg^{-1} seed.

For the coating of the seeds we used the manual method, using transparent plastic bags with a capacity of 5L. Accordingly, the following order of application of products was adopted: fungicide + polymer (without water), where placed directly on the bottom of the bag to a height of approximately 0.30 meters. After that 1.0 kg of seeds was put into the plastic bag and they were shaken for 3 minutes. Subsequently, seeds were dried at room temperature for 48 hours. The treatments consisted of combining two lots and ten coatings, with three replications, totaling 60 experimental units.

The physiological quality of seeds was evaluated by the following tests: Germination: conducted with samples of 200 seeds, with four replicates of 50, in paper rolls, previously moistened with water at a rate of 2.5 times its initial weight, the rolls were kept in an incubator at 25 °C and the count was performed on the eighth day after sowing (Brazil, 2009). Accelerated aging: three samples using 50 grams of seeds were placed in boxes after gerbox containing 40mL of water inside. The seeds were maintained for a period of 48 hours at 41 °C in germination chamber type BOD (Krzyzanowski et al., 1999). After this period, they were subjected to germination test (Brazil, 2009), and evaluated on the fifth day after sowing. Germination test in sand: conducted with samples of 100 seeds, three replicates grown in sealed plastic boxes containing sterile sand, previously moistened with water at 1:10 quantity of their initial weight, after which the plastic boxes were kept in an incubator set at 25 °C. The first count was performed on the fifth day and the final count on the eighth day after sowing, where only normal seedlings were counted.

The statistical design was completely randomized in factorial 2 x 10 (fungicide and treatment) with three replications, totaling 60 experimental units. The data were submitted to ANOVA and they were compared by Tukey test at 5% probability, using the program Assistat version 7.4 beta (Silva & Azevedo, 2006).

Results and Discussion

The germination tests in roll of germitest paper (Table 1) were evaluated at 8 days and showed that the addition of fungicide and polymer decreased significantly the germination of seeds of low germination. The lower germination was observed when the higher dose of the polymer was used; this suggested that may have been phytotoxic due to the low vigor of the seeds. It was further observed that there was no significant difference in seeds of high germination with the use of fungicides alone or in combination with polymers. The products that are applied on seeds should provide sufficient

Table 1. Germination test of seeds coated with polymers and treated with fungicide and placed in germitest paper rolls, Los Cedrales, Paraguay, 2007

Tabela 1. *Germinação de sementes recobertas com polímeros e tratadas com fungicida e semeadas em rolo de papel, Los Cedrales, no Paraguai, 2007*

Treatment	Dose mL per 100 kg^{-1} of seed	Germination (%) Low	High
Control	—-	59 a*	85 a
Fungicide (Thiram + Carbendazim)	200	52 ab	84 a
LEVANYL®	200	53 ab	84 a
LEVANYL® + Fungicide	200 + 200	59 a	81 a
LABORSAN®	200	52 ab	85 a
LABORSAN® + Fungicide	200 + 200	52 ab	87 a
LEVANYL®	350	47 ab	84 a
LEVANYL® + Fungicide	350 + 200	45 b	85 a
LABORSAN®	350	43 b	84 a
LABORSAN® + Fungicide	350 + 200	44 b	84 a
Means		51 B	84 A
C.V. (%)		6.82	

* Means followed by same uppercase and lowercase on the line in the column are not statistically different among themselves by Tukey test at 5% probability.

Table 2. First count of germination of seed coated with polymer and treated with fungicide and placed in sand. Los Cedrales, Paraguai, 2007

Tabela 2. *Primeira contagem da germinação em areia de sementes recobertas com polímero e tratadas com fungicid. Los Cedrales, Paraguai, 2007*

Treatment	Dose mL per 100 kg^{-1} of seed	Germination (%) Low	High
Control	—-	51 a*	87 a
Fungicide (Thiram + Carbendazim)	200	43 a	86 a
LEVANYL®	200	49 a	88 a
LEVANYL® + Fungicide	200 + 200	45 a	89 a
LABORSAN®	200	46 a	87 a
LABORSAN® + Fungicide	200 + 200	44 a	89 a
LEVANYL®	350	47 a	90 a
LEVANYL® + Fungicide	350 + 200	45 a	88 a
LABORSAN®	350	49 a	90 a
LABORSAN® + Fungicide	350 + 200	48 a	87 a
Means		46 B	88 A
C.V. (%)		5.69	

* Means followed by same uppercase and lowercase on the line in the column are not statistically different among themselves by Tukey test at 5% probability.

protection to both seed and seedlings in the field, they also need to keep insects and fungi properly controlled, and they must be mutually compatible to avoid problems with phytotoxicity or narrow spectrum of action (Baudet & Peske, 2006). The producer must be careful when purchasing products because in the liquid formulations the final syrup volume of solution can not exceed 300 mL 50 kg^{-1} of seeds (Henning, 2004).

The test of first count of germination in sand, with evaluations at 5 days (Table 2) showed that there was no statistically significant differences between treatments for high and low seed germination. In some papers published about physiological characteristics of seeds, it has been observed that the application of polymers does not affect the germination and vigor of cotton seeds (Lima et al., 2006). In addition, polymers do not interfere with the action of fungicides used in the treatment of soybean (Pereira et al., 2007). Regardless of the treatment and material used for the germination test, the lot with high initial quality remained higher than the lot with low initial quality.

The results of germination test in sand, evaluated at 8 days (Table 3) also showed no statistically significant differences between control and the treatments with fungicide and polymer, both for seeds with low and high germination. The effect of fungicides used for seed treatment on the physiological quality can vary depending on the chemical product used, which may cause increases (Pereira et al., 2007) or reductions (Gianasi et al., 2000) of the germination and vigor of seeds treated.

However, this study did not show significant differences, regardless of the dosages of fungicides and the type of polymer used for seed treatment. In the first count of seed germination conducted in sand, the seed coats contaminated by fungi remain in sand and they have no contact with the cotyledons, as in the paper rolls, preventing decay and contamination (França Neto & Henning, 1984). It caused decrease of germination in seeds of low germination (Table 1). Seed treatment with fungicide is an important practice to ensure adequate populations of plants in the field of climate and soil with unfavorable conditions (Zorato et al., 2001) and the use of this practice can control important pathogens transmitted by seeds.

Table 3. Germination of seeds placed in sand after being submitted to polymer coating and fungicide, Los Cedrales, Paraguay, 2007

Tabela 3. *Germinação em areia submetidas ao recobrimento com polímero e fungicida, Los Cedrales, no Paraguai, 2007*

Treatment	Dose mL per 100 kg^{-1} of seed	Germination (%) Low	High
Control	—-	53 a*	91 a
Fungicide (Thiram + Carbendazim)	200	47 a	88 a
LEVANYL®	200	51 a	90 a
LEVANYL® + Fungicide	200 + 200	49 a	91 a
LABORSAN®	200	50 a	90 a
LABORSAN® + Fungicide	200 + 200	49 a	90 a
LEVANYL®	350	51 a	92 a
LEVANYL® + Fungicide	350 + 200	48 a	90 a
LABORSAN®	350	53 a	91 a
LABORSAN® + Fungicide	350 + 200	51 a	89 a
Means		50 B	90 A
C.V. (%)		5.16	

* Means followed by same uppercase and lowercase on the line in the column are not statistically different among themselves by Tukey test at 5% probability.

The accelerated aging test (Table 4) showed that there were significant differences for both seeds treated with the polymer, and for seeds treated with fungicide. It follows that for both high and low germination, the treatment with

Table 4. Accelerated aging test of seeds treated with the polymer coating and fungicide, Los Cedrales, Paraguay, 2007

Tabela 4. *Teste de envelhecimento acelerado de sementes recobertas com polímero e tratadas com fungicida, Los Cedrales, no Paraguai, 2007*

Treatment	Dose mL per 100 kg^{-1} of seed	Germination (%) Low	Germination (%) High
Control	—-	39 bc	71 c
Fungicide (Thiram + Carbendazim)	200	48 a*	73 bc
LEVANYL®	200	43 ab	78 abc
LEVANYL® + Fungicide	200 + 200	49 a	81 ab
LABORSAN®	200	34 c	76 abc
LABORSAN® + Fungicide	200 + 200	44 ab	85 a
LEVANYL®	350	42 bc	83 ab
LEVANYL® + Fungicide	350 + 200	42 bc	80 ab
LABORSAN®	350	48 a	82 ab
LABORSAN® + Fungicide	350 + 200	49 a	82 ab
Means		44 B	74 A
C.V. (%)		5.30	

* Means followed by same uppercase and lowercase on the line in the column are not statistically different among themselves by Tukey test at 5% probability.

fungicide and polymer produced better results when compared with the control, demonstrating a beneficial effect of polymers and the fungicide to protect seeds. For the germination and vigor tests, the lot of high germination potential was greater than the lot of low germination potential for all the different coatings tested. Although the treated seeds had higher percentages of germination after accelerated aging, according to Marcos Filho & Shioga (1981), the use of fungicides does not promote changes in the physiological potential of the samples. The data obtained in the accelerated aging test can be higher than those observed in the germination test conducted with the same sample.

These results should be viewed with some caution, and the support of seed pathology is necessary to elucidate the relationship between fungicides/pathogens, because both the temperature and high humidity inhibit the expression of pathogens (Bays et al. 2007). It may be inferred that in the accelerated aging test probably fungicide and polymers have promoted the formation of a mechanical barrier hindering the development of pathogens, with the result that these treatments promote better performance than the control treatment.

CONCLUSION

The application of fungicide and polymer does not affect negatively the seed viability and promotes the vigor of soybean seeds with high germination;

The polymers and the fungicide to protect seeds in the accelerated aging test, ensure the quality of physiological measures;

The seed treatment with fungicide and polymer are most likely to promote physiological quality of soybean seeds with high vigor.

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