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EFFECT OF THE ASSOCIATION BETWEEN INSECTICIDE AND BIOSTIMULANT ON THE PHYSIOLOGICAL QUALITY OF RICE SEEDS

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Abstract

The seed is the vehicle for high productivity crops, as it carries the genetic potential and technology necessary for the success of a crop. And seed treatment has been a very important technology for the initial development of rice seeds. For this reason, the objective of this work was to evaluate the influence of seed treatment with Cruiser Opti insecticide associated with the biostimulant EpívioTM at different dosages and during 0, 60, 90, 135 and 180 days after seed treatment. Rice seeds of the cultivar IRGA 424 RI were used. The treatments were: Control: Permit + Standk + Gaucho, T2- Cruiser Opti (0.5 L/100 Kg of seeds), T3 - EpivioTM (0.1 L/100 Kg of seeds), T4 - Cruiser Opti + EpivioTM (0.5 + 0.05 L/100 kg of seeds), T5 - Cruiser Opti + EpivioTM (0.5 + 0.1 L/100 kg of seeds) and T6 – (0.5 + 0.2 L/100 kg of seeds). Seed quality was monitored through the germination test, cold test and emergence in trays. Under the conditions in which the work was carried out, we can conclude that the treatment composed of Cruiser Opti + EpivioTM, at a dose of 0.5 and 0.1 L/100Kg of seeds, respectively, provided better performance in the germination test in the evaluated periods when compared to the other treatments.

Keywords: *Orysa sativa*; seed treatment; dosages; germination; force.

EFEITO DA ASSOCIAÇÃO ENTRE INSETICIDA E BIOESTIMULANTE NA QUALIDADE FISIOLÓGICA DE SEMENTES DE ARROZ

Resumo

A semente é o veículo para lavouras de alta produtividade, pois carrega em si o potencial genético e tecnologia necessários para o sucesso de uma safra. E o tratamento de sementes vem sendo uma tecnologia de grande importante para o desenvolvimento inicial das sementes de arroz. Por este motivo, o objetivo deste trabalho foi avaliar a influência do tratamento de sementes, com inseticida Cruiser Opti associado ao bioestimulante Epívio^{TM} em diferentes dosagens e durante 0, 60, 90, 135 e 180 dias após o tratamento de sementes. Utilizou-se sementes de arroz da cultivar IRGA 424 RI.

Os tratamentos foram: Testemunha: Permit + Standk + Gaucho, T2- Cruiser Opti (0,5 L/100 Kg de sementes), T3 - Epívio™ (0,1 L/100 Kg de sementes), T4 - Cruiser Opti + Epivio™ (0,5 + 0,05 L/100 kg de sementes), T5 - Cruiser Opti + Epivio™ (0,5 + 0,1 L/100 kg de sementes) e T6 – (0,5 + 0,2 L/100 kg de sementes). A qualidade das sementes foi monitorada através do teste germinação, teste de frio e emergência em bandejas. Nas condições de realização do trabalho podemos concluir que o tratamento composto por Cruiser Opti + Epivio™, na dose de 0,5 e 0,1 L/100Kg de sementes, respectivamente, conferiram melhor desempenho no teste de germinação nos períodos avaliados quando comparado aos demais tratamentos.

Palavras chave: *Orysa sativa*; tratamento de sementes; dosagens; germinação; vigor.

Introduction

Rice is one of the most consumed foods in the world, being the basis of the diet of the population in several countries. It is considered one of the most important foods in the diet of the Brazilian population, especially the less favored class. Characterized as a product of high socioeconomic expression, since, together with beans, it constitutes the basis of the national diet, providing a good combination of vegetable protein and carbohydrates (EMBRAPA, 2020).

In 2021, Brazil produced 11.7 million tons of rice, being the 9th largest producer in the world, participating with 79.3% of Mercosur production followed by Uruguay and Argentina with more than 1.3 million tons for each country (CONAB, 2021). The states that produce the most are mainly Rio Grande do Sul (where most of the national production is located, close to 7.3 million tons in 2020, approximately 70% of the total produced), followed by Santa Catarina (1.1 million tons in 2020). Tocantins is the 3rd largest producer, with harvests reaching close to 1 million tons per year (CONAB, 2021). According to the USDA, world production forecast for the 2021/2022 harvest is over 510 million tons. The world's largest producer is China with 211 million tons, representing 40% of world production. Brazil is the ninth largest grain producer in the world, with more than 11 million tons in the 2021/2022 harvest, which represents more than 2% of world production (USDA, 2022).

The constant increase in the world's population, as well as the limitation of new agricultural frontiers to be explored, makes it necessary to use new and more improved technologies that provide increased productivity in the crop. As a result, strategies that result in increased productivity have been increasingly used in agriculture (SOSBAI, 2020).

As a result of the intensive use of cultivation areas, serious health problems have arisen. The occurrence of diseases and pests are the greatest factors restricting production. The rice plant, at any stage of development, is subject to diseases and pests that reduce both the quality and productivity of the product. Among the direct losses, there is a reduction in the plant stand, stained grains, lower number and/or grain size and reduction in the productive efficiency of these plants (MIURA, 2022).

Thus, the main seed quality attributes are physical, sanitary, genetic and physiological. Being interconnected and dependent on each other, having as physical and sanitary attributes the volumetric weight of the seed, moisture content, mechanical damage, presence of pathogens and contamination (PESKE *et al.*, 2019).

Among the tools that contribute to increased productivity in various crops, including rice, is seed treatment. In a study with the IRGA 417 cultivar, MARZARI *et al.* (2019), observed an increase in rice productivity by 25% with the application of fungicides and insecticides, and this result was obtained in a year with low severity of diseases and pests, a fact that elucidates that the increase in productivity can occur at variable levels.

The increase in the use of seed treatment demonstrates the confidence of producers in the use of this practice. In this context, the present study aimed to evaluate the influence of seed treatment, with the Cruiser Opti insecticide associated with the biostimulant Epivio^{TM} at different dosages, on the storage of rice seeds.

Material and Methods

The work was carried out at the Didactic Laboratory of Seed Analysis (LDAS) of the Faculty of Agronomy Eliseu Maciel of the Federal University of Pelotas (UFPel), Pelotas, RS. Rice seeds of the cultivar IRGA 424 RI, from the company IRGA-RS, were used. The treatments are shown in Table 1.

The tested insecticide was Cruiser Opti and the Biostimulant was EpivioTM, following the manufacturers' recommendations, and the seed treatment was carried out with Syngenta during the month of June 2022. The evaluations were carried out 14 days after the installation of the germination test, 12 days after installation of the cold test and within 10 days after installation of the emergency tray test. These tests were repeated at 0, 60, 90, 135 and 180 days after seed treatment (DAT's).

Table 1. Commercial products, active ingredients, doses for each seed treatment in the rice crop, cultivar IRGA 424 RI.

Treatment	Product	Active ingredient	Concentration (g.i.a/l or Kg)	Dose (L/100 kg of seeds)
Witness	Permit +Standak + Gaucho	Dietholate + Fipronil + Imidacloprid	500 + 250 + 700	0,6+0,12+0,08
T2	Cruiser Opti	TMX + LAMBDA	210	0,5
T3	Epivio™	Brassino+vitamins	100	0,1
T4	Cruiser Opti + Epivio™	TMX + LAMBDA +Brassino+vitamins	210 + 100	0,5+0,05
T5	Cruiser Opti + Epivio™	TMX + LAMBDA +Brassino+vitamins	210 + 100	0,5+0,1
T6	Cruiser Opti + Epivio™	TMX + LAMBDA +Brassino+vitamins	210 + 100	0,5+0,2

The effects of treatments were evaluated using three tests: germination test, cold test and emergence in trays.

Germination test: The 5 repetitions were used with four subsamples of 50 seeds for each treatment. The seeds were sown in paper rolls of the germitest® type, moistened with distilled water, in a proportion of 2.5 times the weight of the dry paper and kept in a germinator set at 25°C. The evaluations were carried out according to the Rules for Seed Analysis (BRASIL, 2009). The count of normal seedlings was performed 14 days after the installation of the test and the results were expressed as percentage of normal seedlings.

Cold Test: The 5 repetitions were used with four subsamples of 50 seeds for each treatment. The seeds were sown in paper rolls of the germitest® type, moistened with distilled water, in a proportion of 2.5 times in relation to the weight of the dry paper, and kept in a refrigerator for seven days at a constant temperature of 10°C. After this period, the rolls were transferred to a germinator set at a constant temperature of 25°C. The evaluations were carried out according to the Rules for Seed Analysis (BRASIL, 2009). The count of normal seedlings was performed five days after the installation of the test and the results expressed as percentage of normal seedlings.

Emergence in trays: Performed by sowing 50 seeds per repetition in trays containing sand substrate. The evaluation was carried out in a count at 10 days after the installation of the test, determining the number of normal seedlings and expressing the results in percentage.

A completely randomized design was used, in a 6 x 5 factorial (6 treatments x 5 repetitions). For the statistical analysis, the Winstat Statistical Analysis System version 1.0 (MACHADO; CONCEIÇÃO, 2003) was used.

Results and Discussion:

When it comes to the germination test (Table 2), it was observed that the control and treatment 3 (Epivio^{TM}) performed worse than the other treatments, in the five evaluation times. The product mixtures did not harm the physiological quality of the seeds, as the averages are above the germination for commercialization, and in the other seasons it remained above this value.

The treatment 2 (Cruiser Opti 0.5 l/ha^{-1}) showed similar behavior between different sowing dates after seed treatment. For sowing times 0 and 60 days after treatment, its behavior was lower when compared to treatments T4, T5 and T6. As for 90 DAT's, treatment 2 did not differ statistically from treatments T4 and T6. At 135 DAT's, treatment 2 showed a better result than treatments T3 and T4, not statistically different from treatments T5 and T6. At 180 DAT's, treatment 2 showed a better result than the control and T3, but did not differ statistically from treatments T4, T5 and T6. Treatment 3 (Epivio^{TM}) performed worse than treatments T2, T4, T5 and T6 in all evaluation times. The combination of Cruiser Opti + Epivio^{TM} at different dosages (T4, T5 and T6) showed a better result than the control, T2 and T3 in all sowing times, but the T5 of Cruiser Opti + Epivio^{TM} at a dosage of 0.5+0.1 l/ha^{-1} showed superior behavior than T4 and T6 in all tested times, not statistically differing only at 135 DAT's when compared to T6 and at 180 DAT's when compared to T4 and T6 there was also no statistical difference. Seed treatment is a technique for applying pesticides or the like on seeds in order to carry out phytosanitary control, which is an agricultural protection measure with localized action. However, seed treatment will only be successful when the correct dose is applied and if the distribution of the product on the surface of the seed is homogeneous (FRANCO *et al.*, 2013).

This technique, in addition to promoting the control of pathogens and pests, can favour the emergence and development of seedlings when exposed to stress (BALARDIN *et al.*, 2011). The insecticides used in seed treatment have systemic action on the plant and, when exposed to the soil, this pesticide is released from the seed due to its low vapor pressure and water solubility.

Thus, as the product is absorbed by the roots, its action will provide the plant with an adequate period of protection against soil and aerial part insects (SILVA, 2018). Grohs *et al.* (2012) observed that rice germination with thiamethoxam was 50% higher than the control. Clavijo (2008) found that rice seeds treated with thiamethoxam had their germination accelerated. According to Castro (2006), thiamethoxam accelerates seed germination by stimulating the activity of enzymes, causing more uniform stands and emergence of seedlings and improvement in initial development.

The treatment of rice seeds with thiamethoxam and lambdacyhalotrin showed an increase in germination. When the test was performed at temperatures of 10 and 13ºC, the treatment response was more pronounced. Rice seeds, untreated, show lower germination at low temperatures (ALMEIDA *et al.*, 2014).

Over the last five years the company responsible for the biostimulant has developed abiotic stress test management capabilities to simulate drought, heat, cold and nutrient stresses. Seed care products resulting from this R&D platform are now marketed under the EPIVIO™ brand in combination with other Seedcare® products to enhance growth while addressing difficult to control plant pathogens, insects and nematodes.

The EPIVIO™ products stimulate plant development by providing micronutrients and biostimulant compounds to the plant and activating soil microflora. The resulting natural symbiotic cycle leads to plants that are stress tolerant. Extensive field trials in Latin America have demonstrated the benefits of an average yield of 5% for soybean growers under a wide range of conditions.

The specifications of each treatment (combination of seed treatment with the evaluation period) are illustrated in Table 1. In general, the treatments affected in a different way the maintenance of seed quality during the storage period, both for germination, cold and emergency test. Seed treatment is a technique for applying pesticides or the like on seeds in order to carry out phytosanitary control, which is an agricultural protection measure with localized action.

Seed treatment will only be successful when the correct dose is applied and if the distribution of the product on the surface of the seed is homogeneous (FRANCO *et al.*, 2013). This technique, in addition to promoting the control of pathogens and pests, can favour the emergence and development of seedlings when exposed to stress (BALARDIN *et al.*, 2011).

Table 2. Percentage of germination of seedlings from rice seeds, cultivar IRGA424 RI treated with a mixture of several products, during five storage periods (0; 60; 90; 135 and 180 days after seed treatment).

Treatments	Product	Germination (%)				
		Evaluation epochs in storage (days)				
		0	**60**	**90**	**135**	**180**
Witness	Permit +Standak + Gaucho	89d*	88d	87d	87c	86c
T2	Cruiser Opti	94bc	94bc	95b	96a	94a
T3	Epivio™	93c	93c	92c	93b	92b
T4	Cruiser Opti + Epivio™	95ab	95ab	95b	95ab	95a
T5	Cruiser Opti + Epivio™	97[a]	96a	97a	97a	95a
T6	Cruiser Opti + Epivio™	95ab	95ab	95b	96a	95a
	CV (%)**	0,98				

* Means followed by the same lowercase letters in the columns do not differ from each other by Tukey's test at 5% probability. CV = coefficient of variation **

The table 3 shows the vigor test data, where for all evaluated times the control showed a lower germination result after the cold test. Treatment 2, containing only Cruiser Opti (0.5 $L.ha^{-1}$) showed a statistical difference when compared to the control and treatment 3, containing only Epivio™ at all times tested, except for the 60 DAT's, where Epivio™ presented a statistically superior result if compared to treatment 2 containing only Cruiser Opti.

In the initial periods of evaluation at 0 and 60 DAT's, treatments T4 and T6 where the difference is the doses of the product Epivio™ did not show statistical differences between them. Treatment 5, on the other hand, presented a better result than treatment T4 and T6 for periods of 0, 60 and 90 DAT’s. At 135 and 180 DAT's, treatments T5 and T6 performed better than the others, but not statistically different from each other.

The witness presented a lower result than the others. According to Almeida *et al.* (2011), the treatment of seeds with some insecticides activates several physiological reactions, such as the expression of membrane proteins, which interact with several defense mechanisms, allowing the plant to better withstand adverse conditions. When treating rice seeds with thiamethoxam during storage, a reduction in the rate of loss of germination and vigor is observed when compared to untreated seeds (BINSFELD *et al.*, 2017).

As the perception of seed value increases and the importance of protecting and/or improving its performance, the availability of seed treatment products grows in the market, with different purposes, such as protection (fungicides or insecticides) or nutrition (micronutrients), with the aim of improving seed performance, both in the physiological and economic aspects (BALARDIN *et al.*, 2011).

Table 3. Percentage germination of seedlings from rice seeds, after the cold test, cultivar IRGA424 RI treated with a mixture of several products, during five storage periods (0; 60; 90; 135 and 180 days) after seed treatment.

Treatments	**Product**	**Cold Test (%)**				
		Evaluation epochs in storage (days)				
		0	**60**	**90**	**135**	**180**
Witness	Permit +Standak + Gaucho	86d*	87c	86c	86c	84 c
T2	Cruiser Opti	93bc	93 b	93ab	94ab	93ab
T3	Epivio^{TM}	92 c	94ab	92 c	92b	91b
T4	Cruiser Opti + Epivio^{TM}	94 ab	94ab	94ab	94ab	93ab
T5	Cruiser Opti + Epivio^{TM}	96 a	96 a	96a	95a	96 a
T6	Cruiser Opti + Epivio^{TM}	95 ab	94ab	95b	94a	94 a
CV (%)**				1,14		

* Means followed by the same lowercase letters in the columns do not differ from each other by Tukey's test at 5% probability. CV = coefficient of variation **

At season 0 (Table 4), the control had a lower performance than the other treatments at all evaluated times. Treatment 3 showed superior behavior compared to the control and inferior to the other treatments at all times evaluated except at 180 days, where treatments T2, T3, T4, T5 and T6 did not differ statistically.

Table 4. Seedling emergence in trays derived from rice seeds, cultivar IRGA424 RI treated with a mixture of several products, during five storage periods (0; 60; 90; 135 and 180 evaluation periods after seed treatment).

Treatments	**Product**	**Emergency (%)**				
		Evaluation epochs in storage (days)				
		0	**60**	**90**	**135**	**180**
Witness	Permit +Standak + Gaucho	87 d*	87 c	86 d	86 c	85 b
T2	Cruiser Opti	93 bc	93 ab	93 b	94 a	93 a
T3	Epivio^{TM}	92 b	92 b	91 c	91 b	92 a
T4	Cruiser Opti + Epivio^{TM}	94 ab	94 ab	94 ab	93 ab	93 a
T5	Cruiser Opti + Epivio^{TM}	95 a	95 a	96 a	94 a	93 a
T6	Cruiser Opti + Epivio^{TM}	95 a	94 ab	94 ab	93 ab	92 a
	CV (%)**	1,10				

* Means followed by the same lowercase letters in the columns do not differ from each other by Tukey's test at 5% probability. CV = coefficient of variation **

The other treatments showed emergence greater than 90% throughout the evaluated period. Treatment 5 showed a better result than treatments T4 and T6 in all seasons except for season 0 and 180 DAT's, where it did not differ statistically between T6, T4 and T5, respectively. These data corroborate Almeida *et al.* (2019), who showed that seed treatment contributes to slower seed vigor loss caused by storage when compared to untreated seeds.

Conclusion

When analyzing all treatments, germination, emergence, cold test and periods after treatment (0 to 180 days), treatment 5 of Cruiser Opti + EpivioTM at a dosage of 0.5+0.1 L.ha-1, respectively presented more consistent results. Which ends up confirming the objective of this study where rice seeds treated with Cruiser Opti + EpivioTM can be stored for 180 days after treatment without causing losses in the physiological quality of the seeds.

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