Agrária - Revista Brasileira de Ciências Agrárias
ISSN (on line) 1981-0997
v.9, n.3, p.317-321, 2014
Recife, PE, UFRPE. www.agraria.ufrpe.br
DOI:10.5039/agraria.v9i3a2162
Protocolo 2162 - 20/03/2012 • Aprovado em 14/04/2014

Use of thiamethoxam as bioactivator on cucumber seed physiological quality and seedling performance

Jucilayne F. Vieira[1], Vanessa N. Soares[1], Francisco A. Villela[1], José E. F. Espinola[2], Fernando da R. Castanho[1], Tainan L. de Almeida[1]

[1] Universidade Federal de Pelotas, Pós Graduação em Ciência e Tecnologia de Sementes, Campus Universitário, Capão do Leão, CEP 96001-970, Pelotas-RS, Brasil. E-mail: laynevieira@yahoo.com.br; vnsoares@gmail.com; francisco.villela@pq.cnpq.br; fernando-castanho@hotmail.com; tainanlopes.92@hotmail.com
[2] Universidade Federal da Paraíba, Centro de Ciências Humanas Sociais e Agrárias, Campus Universitário III, CEP 58220-000, Bananeiras-PB, Brasil. E-mail: jefeespinola@hotmail.com

ABSTRACT

This study aimed to evaluate the effect of insecticide thiamethoxam as a bioactivators on cucumber seed physiological quality and seedling performance. The treatments used were: T_1 = no product; T_2 = 0.2 L of product per 100 kg of seeds; T_3 = 0.3 L product per 100 kg of seeds; T_4 = 0.4 L of product per 100 kg seeds; T_5 = 0.5 L of product per 100 kg of seeds; T_6 = 0.6 L of product per 100 kg of seeds. The variables evaluated were: seed germination, first count of germination, seedling root length, accelerated aging, cold test and seedling emergence. The experimental design was completely randomized with three replicates for each treatment and data were analyzed by regression. Doses of thiamethoxam from 0.3 to 0.4 L (per 100 kg of seed) provide positive effects on cucumber seed physiological quality and seedling performance, as was shown in germination and vigor tests results.

Key words: *Cucumis sativus* L., insecticide, physiological quality, vegetable seeds, vigor tests

Uso de tiametoxam como bioativador na qualidade fisiológica de sementes e desempenho de plântulas de pepino

RESUMO

Nesse trabalho o objetivo foi avaliar o efeito do inseticida tiametoxam como biativador na qualidade fisiológica de semente e no desempenho de plântula de pepino. Os tratamentos utilizados foram: T_1 = sem produto; T_2 = 0,2 L do produto por 100 kg de sementes; T_3 = 0,3 L do produto por 100 kg de sementes; T_4 = 0,4 L do produto por 100 kg de sementes; T_5 = 0,5 L do produto por 100 kg de sementes e T_6 = 0,6 L do produto por 100 kg de sementes. As variáveis avaliadas foram germinação, primeira contagem de germinação, comprimento de raiz, envelhecimento acelerado, teste de frio e emergência de plântulas. O delineamento experimental foi inteiramente casualizado com três repetições para cada tratamento. Os dados foram submetidos à análise por regressão polinomial. Doses de 0,3 a 0,4 L de tiametoxam (por 100 kg de sementes) proporcionam efeitos positivos na qualidade fisiológica das sementes e no desempenho de plântulas de pepino, como se pode observar nos resultados do teste de germinação e de vigor.

Palavras-chave: *Cucumis sativus* L., inseticida, qualidade fisiológica, sementes de hortaliças, testes de vigor

Introduction

Cucumber (*Cucumis sativus* L.) a vegetable from the Curcubitaceae family is a very important crop produced and consumed in Brazil. Brazilian cucumber seed marketing generates approximately seven million dollars per year (Carvalho et al., 2013) and because seeds have high commercial value they deserve special attention regarding their physiological and sanitary quality, therefore, studies on seed physiological quality are very important to increase crop production (Abdo et al., 2005). Seed treatments impact the seeding rate by increasing the percentage of seeds that ultimately contribute to the stand and seed treatments may also increase yields through improved plant health (Trybom, 2010).

The different active ingredient used in seed treatment provides protection to insects and pathogens. In addition, the use of systemic insecticide, depending on its chemical composition, may positively influence the physiological seed quality and seedling performance in the field. Generally, insecticides and fungicides have been evaluated for efficiency control in pests and diseases, but some can cause still unknown effects that could modify the metabolism and plant morphology (Castro et al., 2007).

Among modern agricultural practices, the use of bioactivators is a practice that has been used to increase productive capacity and its use in agriculture has also increased (Serciloto, 2002). The bioactivators are complex organic substances that modify the growth of plants, capable of acting in the transcription of DNA in plant gene expression, membrane proteins, metabolic enzymes and mineral nutrition (Castro et al., 2008). When applied to plants, these bioactivators can modify or alter specific metabolic and physiological processes, such as increase cell division and elongation; chlorophyll stimulation of synthesis and photosynthesis, flower bud differentiation, increase life of plants, low effects of adverse weather conditions as well as increased absorption of nutrients, set and increase fruit size (Cataneo et al., 2006).

Thiamethoxam is a product that has demonstrated potential to increase seed vigor and seedling performance (Acevedo & Clavijo, 2008; Lauxen et al., 2010). This bioactivator stimulates the physiological performance of carrot seeds, increasing significantly the expression of seed germination and seedlings vigor (Almeida et al., 2009). The treatment of cotton seeds with thiamethoxam positively favours the physiological quality of seeds (Lauxen et al., 2010). Increase in soybean seed vigor, productivity, leaf area and root, more uniform stand, uniform emergence and better early development were observed (Castro, 2006). Also in soybeans, Cataneo (2008), noted that thiamethoxam accelerates seed germination during the imbibition process, inducing the development of the embryonic axis, and the response of the seeds treated with this product is greater under conditions of stress (water deficit, salinity and the presence of aluminium in the soil). In this context, this study aimed to evaluate the effect of insecticide thiamethoxam as a bioactivators on cucumber seed physiological quality and seedling performance.

Material and Methods

This study was conducted in the Didactic Laboratory of Seed Analysis and in a greenhouse at Federal University of Pelotas. Cucumber seeds (*Cucumis sativus* L.), genotype "Guarani Macho" provided by ''Vida Sul sementes'' were used. Each dose of the tiamethoxam was distributed in plastic bags and then the seeds were placed and agitated for five minutes. A volume of solution (product + water) was used to promote sufficient distribution of product on the seeds and the total suspension volume was 1L.

The treatments were: T_1 = no product, T_2 = 0.2 L product per 100 kg of seeds, T_3 = 0.3 L of product per 100 kg of seeds, T_4 = 0.4 L of product per 100 kg of seeds, T_5 = 0.5 L of product per 100 kg of seeds, T_6 = 0.6 L product per 100 kg of seeds. The treated seeds were submitted to natural drying for 24 h. After this time, the following assessments were conducted:

Germination test: was conducted at 20 °C with 200 seeds per treatment (four replicates of 50 seeds); the seeds were distributed according to Brasil (2009) on two sheets of paper, previously moistened with distilled water in an amount equivalent to 2.5 times the mass of paper and placed on paper. Evaluations were conducted at four and eight days after sowing and the results expressed in percentage of normal seedlings.

First count of germination: was conducted in conjunction with the seed germination test, by computing the percentage of normal seedlings on the fourth day after sowing (Brasil, 2009).

Accelerated aging traditional: was conducted with 200 seeds (four replicates of 50 seeds) per treatment and the seeds were distributed over an aluminum screen placed inside a plastic box (gerbox) containing 40 mL of distilled water, maintained at 41 °C for 48 h. After this period, the seeds were put to germinate following the methodology used in the germination test described above and the percentage of normal seedlings was assessed on the fourth day after sowing (Brasil, 2009).

Seedlings root length (main root): twelve subsamples of 10 seedlings for each treatment were used. The seeds were sown in rolled paper "germitest", moistened with distilled water at amount of 2.5 times the dry weight of the paper, and kept in the incubator 20 °C and the length of the root system was measured on the fourth day after sowing and the results expressed in cm per plant.

Cold test: was performed with 200 seeds for each treatment (four replicates of 50 seeds). The seeds were sown on germitest paper, moistened with distilled water at a ratio of 2.5 times the weight of dry paper and kept in cold storage for seven days at 10 °C. The paper rolls were then transferred to an incubator at 20 °C. The count of normal seedlings was performed four days and the results expressed as percentage of normal seedlings and the evaluations were performed in accordance with the Rules for Seed Analysis (Brasil, 2009).

Seedling emergence: a total of 200 seeds (four replicates of 50 seeds) per seed lot were distributed in polystyrene trays with 200 cells filled with commercial substrate Plantmax®. Evaluations were performed at 12 days after sowing, computing the normal seedlings and the results expressed as percentage of normal seedlings emerged.

The experimental design was completely randomized with three replicates and data were analyzed by statistical program WinSTAT submitted to regression analysis after variance analysis.

Results and Discussion

Germination percentage and first count of germination followed a quadratic response with the highest germination observed for seeds treated with insecticide at doses between 0.3 and 0.4 L per 100 kg of seeds (Figure 1 and 2); however, reduction in germination percentage was seen at above 0.5 L per 100 kg of seeds. Seeds treated with thiamethoxam had positive effects as rapid germination and better initial impulse in relation to the untreated seeds probably because treated seeds had their germination accelerated by stimulating activities of enzymes. Thiamethoxam accelerates germination, and induces further development of the embryonic axis (Cataneo, 2008). These results are similar to those obtained by Cataneo (2008) in soybean seeds and Almeida et al. (2009) in carrot seeds, these authors have found that seed treated with thiamethoxam showed higher germination percentage and acceleration of seed germination in relation to untreated seeds. It was also observed that thiamethoxam stimulates the rapid growth of soybean plants, presenting the greatest potential for initial vigor, germination and root development (Gasparin & Cruz-Silva, 2007).

The application of different doses of thiamethoxam resulted in a significant quadratic response and the doses between 0.3 and 0.4 L per 100 kg of seeds corresponded to the highest values of the seed germination after accelerated aging of seeds, reaching almost 99% (Figure 3). In comparison to the control treatment the seed treatment with thiamethoxam showed increase of 20 percentage points in seed germination (Figure 3).

It was observed that thiamethoxam conferred the seeds protection from stress caused by accelerated aging. This effect can be attributed to the fact that bioactivator moves within the plant cells by activating several physiological reactions, such as activation of proteins that act in the defence system of plants against stress caused by drought, high temperatures, among others, increasing productivity, as observed in soybeans by Tavares & Castro (2005).

The seedlings root length originating from seeds treated with bioactivator showed significant increase when compared to the seedlings originating from untreated ones (Figure 4). Thiamethoxam increases the level of cytokinin, which induces greater root development, increasing water absorption and forces the plant stomata to lose water, which benefits the metabolism and enhancing the stress resistance (Bernardes, 2006). Other authors observed that seedlings from seed treated with thiametoxam had significant higher root length than the controls (Tavares et al., 2007; Almeida et al., 2009; Lauxen et al., 2010). Therefore, the positive effects on root growth in this study suggest that further experiments by improving the treatment and dose to cucumber seeds and

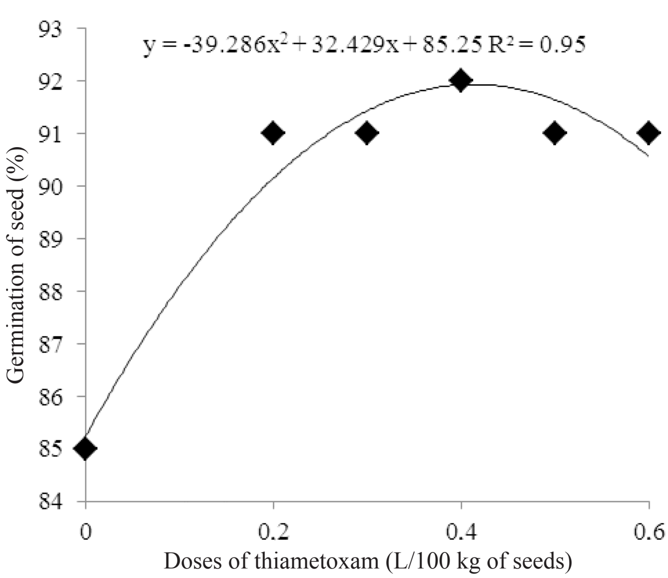

Figure 1. Germination of cucumber seed, “Guarani cultivar Macho”, submitted to different doses of thiamethoxam

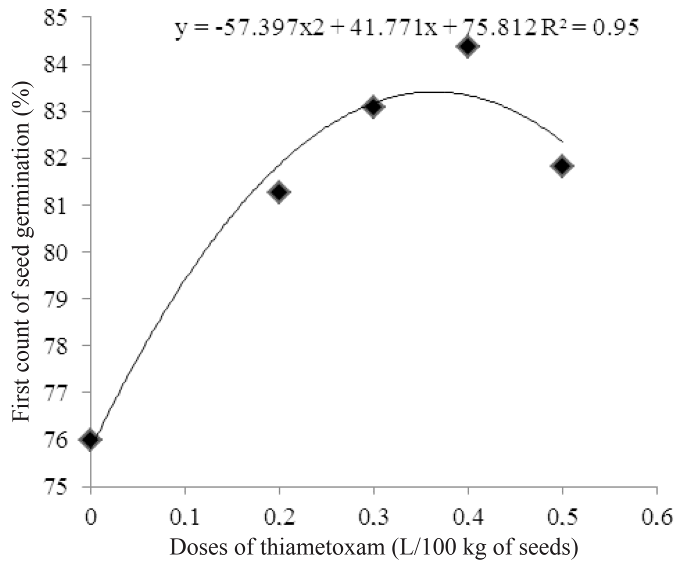

Figure 2. First germination of seeds cucumber, “Guarani cultivar Macho”, submitted to different doses of thiamethoxam

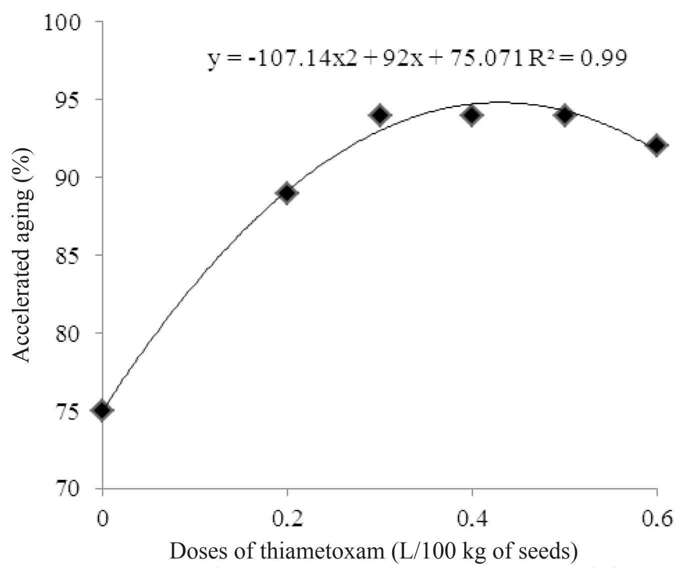

Figure 3. Percentage of seed germination after accelerated aging of “Guarani cultivar Macho”, submitted to different doses of thiamethoxam

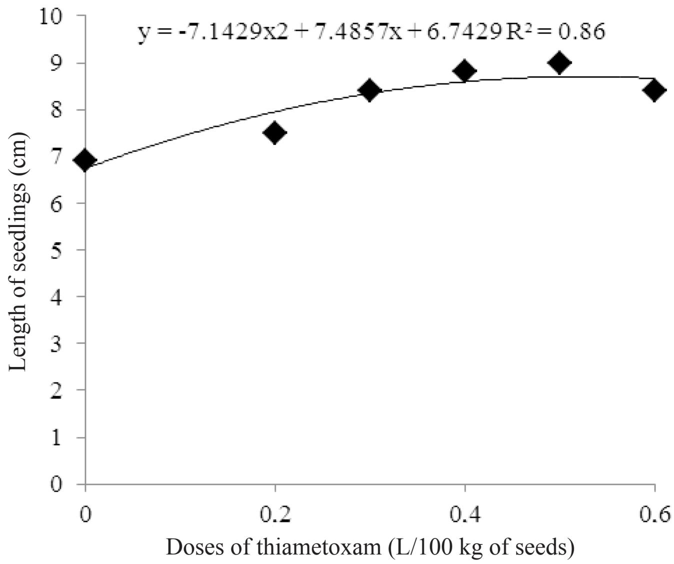

Figure 4. Cucumber seedlings root length, "Guarani cultivar Macho submitted to different doses of thiamethoxam

to other vegetable seeds should be continued to obtain better results.

The results of cold test (Figure 5) shows that some of the doses favour seed germination after exposure to low temperature, with a quadratic response, the highest values were observed between doses of 0.3 and 0.4 L/100 kg of seeds, because the seeds treated with these doses showed higher seed germination percentage.

In the field, plants are exposed to many types of biotic or abiotic stresses. According to Almeida et al. (2009) seeds treated with thiamethoxam result in seedlings that are more tolerant to these stresses and, thus, they can develop more vigorously in unfavorable conditions, increasing the chances of reaching its genetic potential for productivity. The effects of the insecticide on seedling emergence were not statistically significant. However, it is important to emphasize that, in the different vigor tests positive response were found from the application of increasing doses of thiamethoxam, being generally more effective at doses between 0.3 and 0.4 L/100 kg of seeds. These results are very promising because it increases seed vigor and can favour the initial establishment of cucumber seedlings in the field, particularly under unfavourable environmental conditions.

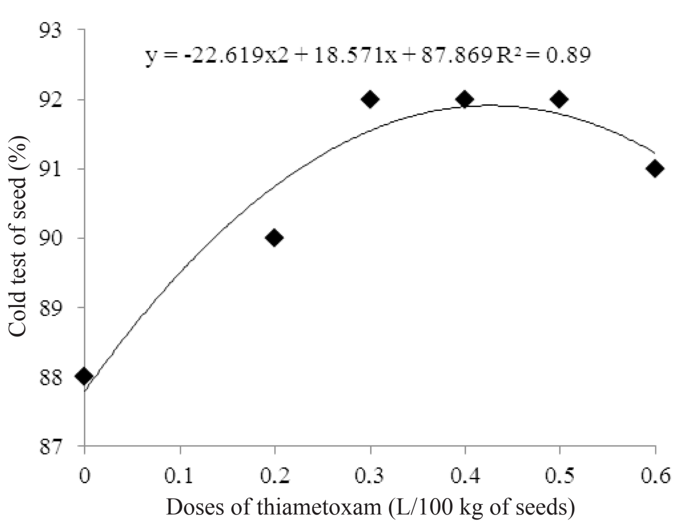

Figure 5. Percentage of normal cucumber seedlings of "Guarani cultivar Macho", after submitted to different doses of thiamethoxam and cold test

Conclusion

Doses of thiamethoxam from 0.3 to 0.4 L per 100 kg of seeds provide positive effects on cucumber seed physiological quality and seedling performance, as was shown in germination and vigor tests.

Literature Cited

Abdo, M. T. V. N.; Pimenta, R. S.; Panobianco, M.; Vieira, R. D. Testes de vigor para avaliação de sementes de pepino. Revista Brasileira de Sementes, v.27, n.1, p.195-198, 2005. <http://dx.doi.org/10.1590/S0101-31222005000100025>.

Acevedo, J. C.; Clavijo, J. Investigación agronômica em Colombia. In: Clavijo, J. (Ed.). Tiametoxam: un nuevo concepto em vigor y produtivad. Bogotá: Arte Litográfico, 2008. p.41-91.

Almeida, A. S.; Tillmann, M. A. A.; Villela, F. A.; Pinho, M. S. Bioativador no desempenho fisiológico de sementes de cenoura. Revista Brasileira de Sementes, v.31, n.3, p.87-95, 2009. <http://dx.doi.org/10.1590/S0101-31222009000300010>.

Bernardes, J. Bioativador estimula produção de hormônios responsáveis pelo crescimento da soja. São Paulo: Agência USP de Notícias, 2006. (Boletim. 1907) <http://www.usp.br/agen/bols/2006/rede1907.htm#primdestaq>. 27 Jun. 2011.

Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Regras para análise de sementes. Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Brasília, DF: MAPA/ACS, 2009. 395p.

Carvalho, A. D. F.; Amaro, G. B.; Lopes, J. F.; Vilela, N. J.; Michereff Filho, M.; Andrade, R. Cultura do pepino. Gama: Embrapa Hortaliças, 2013. 18p. (Embrapa Hortaliças. Circular Técnica, 113).

Castro, P. R. C.; Pitelli, A. M. C. M.; Peres, L. E. P.; Aramaki, P. H. Análise da atividade hormonal de tiametoxam através de biotestes. Revista de Agricultura, v.83, n.3, p.208-213, 2008.

Castro, P. R. C. Agroquímicos de controle hormonal na agricultura tropical. Piracicaba: ESALQ, 2006. 46p. (Série Produtor Rural, 32).

Castro, P. R. C.; Pitelli, A. M. C. M.; Peres, L. E. P.; Aramaki, P. H. Análise da atividade reguladora de crescimento vegetal de tiametoxam através de biotestes. Publicatio UEPG, v.13, n.3, p.25-29, 2007. <http://www.revistas2.uepg.br/index.php/exatas/article/viewFile/892/774>. 27 Jun. 2011.

Cataneo, A. C. Ação do Thiametoxam sobre a germinação de sementes de soja (*Glycine max* L.): Enzimas envolvidas na mobilização de reservas e na proteção contra situação de estresse (deficiência hídrica, salinidade e presença de alumínio). In: Gazzoni, D. L. (Ed.). Tiametoxam: uma revolução na agricultura brasileira. Petrópolis: Vozes, 2008. p.123-192.

Cataneo, A. C.; Andréo, Y.; Seiffert, M.; Búfalo, J.; Ferreira, L. C. Action of Cruiser insecticide on germination of soybeans seed under stress conditions. In: Brazilian Congress Of Soybean, 4., 2006, Londrina. Annals... Londrina: Embrapa Soja, 2006. p.90.

Gasparin, M. B.; Cruz-Silva, C. T. A. Efeito de fungicida e inseticida na germinação e desenvolvimento da soja (*Glycine max* (L.) Merril). Cascavel: FAG, 2007. 17p. <http://www.fag.edu.br/tcc/2007/Ciencias_Biologicas_Bacharelado/EFEITO_DE_FUNGICIDA_E_INSETICIDA_NA_GERMINA%C3%87AO_E_DESENVOLVIMENTO_DA_SOJA.pdf>. 27 Nov. 2009.

Lauxen, L. R.; Villela, F. A.; Soares, R. C. Desempenho fisiológico de sementes de algodoeiro tratadas com tiametoxam. Revista Brasileira de Sementes, v.32, n.3, p.61-68, 2010. <http://dx.doi.org/10.1590/S0101-31222010000300007>.

Serciloto, C. M. Bioativadores de plantas. Revista Cultivar HF, v.13, n.1, p.20-21, 2002.

Tavares, S.; Castro, P. R. C. Avaliação dos efeitos fisiológicos de Cruiser 35FS após tratamento de sementes de soja. Piracicaba: ESALQ/Syngenta, 2005. p.1-13. (Relatório técnico ESALQ/Syngenta).

Tavares, S.; Castro, P. R. C.; Ribeiro, R. V.; Aramaki, P. H. Avaliação dos efeitos fisiológicos do tiametoxam no tratamento de sementes de soja. Revista de Agricultura, v.82, n.1, p.47-54, 2007.

Trybom, J. Effect of seeding rate and seed treatment on soybean performance. Field facts, v.8, n.2, p.1-3, 2010. <http://www.derekerbseeds.ca/uploads/planting_effectofseedingrateandseedtreatmentonsoybeanperformance.pdf>. 10 Mar. 2014.