University of São Paulo
“Luiz de Queiroz” College of Agriculture

**Efficacy of a Novel Nematicidal Seed Treatment
against *Pratylenchus brachyurus* and *Heterodera glycines* in
soybean**

Daniela Roncato Ribeiro

Dissertation presented to obtain the degree of Master
in Science. Area: Plant Pathology

Piracicaba
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Agricultural Engineer

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Advisor:
Prof. Dr. **MARIO MASSAYUKI INOMOTO**

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RESUMO

Eficácia do novo tratamento de sementes com nematicida contra *Pratylenchus brachyurus* e *Heterodera glycines* em soja

Os nematoides do cisto da soja (NCS, *Heterodera glycines*) e da lesão radicular (NLR, *Pratylenchus brachyurus*) estão entre os patógenos que mais limitam o rendimento da soja (*Glycine max* L.) no Brasil. Combinações de métodos de controle, incluindo rotação de culturas e uso de cultivares resistentes não são completamente eficientes, sendo necessária a busca por novas estratégias. O tratamento de sementes com nematicida é uma opção promissora para o manejo de nematoides. Neste contexto, a Syngenta lançará ciclobutrifluram, um novo ingrediente ativo. Portanto, o registro desta molécula fornecerá uma ferramenta valiosa para os produtores brasileiros manejarem NCS e NLR. Os objetivos deste estudo foram avaliar os efeitos do tratamento de sementes nas populações de ambos nematoides e os efeitos na produtividade de soja. Além disso, foram avaliados possíveis efeitos fitotóxicos do tratamento de sementes com nematicida sintético na mesma cultura. Ensaio em casa de vegetação e microplots foram realizados em Holambra, Estado de São Paulo, entre 2017 e 2019 para *H. glycines* e *P. brachyurus*. Testes de campo também foram realizados em 15 ambientes durante o mesmo período. Geralmente, o ciclobutrifluram reduziu o número de nematoides por grama de raiz (dose ≥ 40 g ingrediente ativo/100 kg de sementes de soja) e resultou em um aumento na produtividade de algumas cultivares em comparação ao tratamento contendo abamectina (50 g i.a./100 kg de sementes) e ao controle. Além disso, o ciclobutrifluram não exibiu fitotoxicidade nas sementes, plântulas e o desenvolvimento das plantas foi semelhante aos das não tratadas. Com base nesses estudos, o novo tratamento de sementes com nematicida sintético tem o potencial de controlar os NCS e o NLR, sem o risco de fitotoxicidade.

Palavras-chave: Soja: *Glycine max*, NCS: nematoide do cisto de soja, NLR: nematoide da lesão radicular

ABSTRACT

Efficacy of a novel nematicidal seed treatment against *Pratylenchus brachyurus* and *Heterodera glycines* in soybean

The soybean cyst nematode (SCN, *Heterodera glycines*) and the root lesion nematode (RLN, *Pratylenchus brachyurus*) are among the most yield limiting pathogens of soybean (*Glycine max* L.) in Brazil. Combinations of control methods, including crop rotation and the use of resistant cultivars are not completely efficient and the search for novel strategies is needed. Nematicidal seed treatment is a promising and welcome option to manage nematodes. In this context, Syngenta will launch cyclobutrifluram, a novel active ingredient. Therefore, the registration of this molecule will provide a valuable tool for Brazilian growers to manage both SCN and RLN. The objectives of this study were to evaluate seed treatment effects on SCN and RLN populations and the impact on soybean yield. Furthermore, the phytotoxicity of cyclobutrifluram to soybean seeds and seedlings was also evaluated. Greenhouse and microplot trials were conducted in Holambra, São Paulo State in 3 years (from 2017 to 2019) for *P. brachyurus* and *H. glycines*. Generally, cyclobutrifluram greatly reduced the number of nematodes per grams of roots (at the rate ≥ 40 g active ingredient/100 kg of soybean seeds) and resulted in a yield increase of some cultivars compared to the treatment containing only abamectin (at the rate of 50 g a.i./100 kg of soybean seeds) and the check. Additionally, cyclobutrifluram did not exhibit any phytotoxicity effect to soybean seeds and seedlings and the growth of plants was similar to those of the untreated plants. Based on these studies, the novel nematicidal seed treatment has the potential to control both SCN and RLN populations in soybean fields in Brazil, without the risk of phytotoxicity.

Keywords: Soybean: *Glycine max*, SCN: soybean cyst nematode, RLN: root lesion nematode

1. INTRODUCTION

Soybean [*Glycine max* (L.) Merr] is a globally important crop and the dominant oilseed in Brazil. There are numerous limiting factors to soybean production, among them the plant parasitic nematode occurrence, which can cause an estimated crop loss from \$US80 billion to \$US157 billion globally (NICOL et al., 2011). In Brazil, the two most economically important species for soybean are the cyst nematode (SCN), *Heterodera glycines* Ichinohe and the root lesion nematode (RLN) *Pratylenchus brachyurus* (Godfrey) Filipjev & Schuurmans Stekhoven (MOENS et al., 2010).

The management of both species is complex and requires the combination of methods, including the use of resistant and tolerant cultivars, nematicides and crop rotation. RLN is currently one of the main concerns to soybean fields in Brazil. Losses may reach up to 50% in the Midwest region of this country (FRANCHINI et al., 2014). Controlling this nematode is a concern, due to the scarcity of resistant cultivars. Brazilian growers have adopted two main strategies to control RLN, including crop rotation with antagonistic plants and chemical or biological nematicides (INOMOTO, 2006; INOMOTO et al., 2008), however they are not completely satisfactory.

Also, a similar scenario can be found for the management of *H. glycines*. SCN populations differed in resistance genetics, once they are categorized into Hg types based on their virulence to soybean cultivars (NIBLACK; LAMBERT; TYLKA, 2006; TYLKA, 2016). The use of resistant cultivars is becoming less effective, because SCN populations are able to overcome the resistance (NIBLACK; LAMBERT; TYLKA, 2006).

Hence, the low efficiency of the cultivars available for these nematodes and the limitations on the use of the current nematicides have increased the interest of a constant search for novel nematicides. Moreover, in this context, seed treatment has been characterized as an important strategy in the marketplace, including the fact that it is least expensive, easiest application method and efficient.

Thus, the present study was conducted to report cyclobutrifluram (A22417), a new synthetical nematicide seed treatment with a novel active ingredient that is designed to provide consistent broad-spectrum control of nematodes in soybean. Cyclobutrifluram belongs to the family of systemic fungicides known as the succinate dehydrogenase inhibitors (SDHI), an active substance used to control fungal diseases (ISHII et al., 2011; VITALE; PANEBIANCO; POLIZZI, 2016).

Therefore, the aim of this study was to evaluate the efficacy of soybean seed treatment with the nematicide A22417 in greenhouse and microplot conditions to predict its potential to

reduce SCN and RLN populations. Field trials were also carried out across different environments to detect if A22417 has effects on soybean yield.

6. CONCLUSION

This study showed that cyclobutrifluram from the rate of 40 g a.i./100 kg of soybean seeds was consistently an effective synthetical nematicide seed treatment of soybean seeds in reducing the number of *P. brachyurus* and *H. glycines* per grams of root compared to check inoculated seeds and abamectin. Therefore, it represents another chemical option for nematode control that can be viably introduced into an integrated nematode management program.

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