

Pea seed treatment for *Rhizoctonia solani* control¹

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ABSTRACT - The objectives of this study were to evaluate the efficiency of fungicides for pea seed treatment against damping-off caused by *Rhizoctonia solani* and to verify their effects on physiological seed quality. 'Mikado' pea seeds were treated with the following fungicides: Carbendazim, Carbendazim + Thiram, Captan, Iprodione, Iprodione + Thiram, Metalaxyl-M + Fludioxonil, Pencycuron, Procymidone and Tolyfluanid. Control seeds were treated with deionized water. Physiological seed quality was evaluated with the following tests: germination, first count, accelerated aging and electrical conductivity. Seeds were sown in soil inoculated and no inoculated with *R. solani*. The experimental design was completely random with four replications. Seedling emergence was reduced in inoculated soil and the best treatments for *R. solani* control were Carbendazim, Pencycuron, Iprodione and Carbendazim + Thiram. Captan reduced seed physiological quality in both the laboratory and field.

Index terms: *Pisum sativum*, germination, stand establishment, fungicides, pathogens.

Desempenho de sementes de ervilhas em função do controle químico de *Rhizoctonia solani*

RESUMO - Durante o estabelecimento das lavouras de ervilha, a ocorrência de *Rhizoctonia solani* causando tombamento de plântulas tem sido observada. O presente trabalho teve como objetivo verificar a eficiência do uso de fungicidas no tratamento de sementes de ervilha cultivar Mikado, visando o controle de *Rhizoctonia solani* e seus efeitos na qualidade fisiológica dessas sementes. Sementes foram tratadas com os seguintes fungicidas: Carbendazim, Carbendazim + Thiram, Captan, Iprodione, Iprodione + Thiram, Metalaxil-M + Fludioxonil, Pencycuron, Procimidone e Tolifluanida. Como testemunha, foi utilizada sementes tratadas com água destilada. A avaliação da qualidade fisiológica das sementes após o tratamento foi realizada pelos seguintes testes: germinação, primeira contagem, envelhecimento acelerado, condutividade elétrica e emergência de plântulas. As sementes tratadas foram semeadas em solo não inoculado e inoculado com *R. solani*. A emergência de plântulas foi reduzida em solo inoculado, sendo que os tratamentos que apresentaram melhores resultados foram Carbendazim, Pencycuron, Iprodione e Carbendazim + Thiram. O fungicida Captan prejudicou a qualidade fisiológica das sementes tanto em laboratório como no campo. Com relação à germinação, os tratamentos que apresentaram melhores resultados foram Carbendazim, Pencycuron, Iprodione e Carbendazim + Thiram.

Termos para indexação: *Pisum sativum*, germinação, estabelecimento de plântulas, fungicidas, patógenos.

Introduction

Pea (*Pisum sativum* L.) belongs to the *Fabaceae* family, and it is originated from temperate climate regions with a centre of origin in the Middle East, India, Afghanistan and Ethiopia (Couto, 1989). Peas have a high nutritional value and are much appreciated as a legume throughout the world. They may be consumed as seeds (green or dried, rehydrated), used for animal feed and also as green manure (Sharma and Fonseca, 2000).

In Brazil, peas were almost entirely imported until the 1980s but today all domestic demand may be supplied by local production. According to IBGE (2009) data, Brazil grows 2,000 ha of peas with a production of around 6,000 tons and a mean productivity of 2,753 Kg.ha⁻¹.

One of the main diseases affecting pea production is *Rhizoctonia solani* Khun causing damping-off (CAB, 1999), in pre or post emergence. In pre-emergence, the seed is infected by the pathogen at the beginning of germination, causing

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seed rotting. When damping-off occurs in post-emergence, the pathogen affects the base of the plant stem, causing tissue softening and constriction so that the stem may often not support the weight of the plant and it falls over (Lopes et al., 2005). Silva et al. (1996) reported that if *R. solani* is present in the soil or still present on the seeds, besides causing significant seedling losses, it may also serve as an inoculum source for future crops.

Among the recommended control measures is the use of healthy seeds, the crop rotation, the pre-incorporation of residues and the control of water during early crop growth (Vieira, 1988). However, the principal and most economic measure adopted until now to minimize the adverse effects of this disease has been fungicide seed treatment (Carvalho et al., 1985; Cia and Salgado, 1997; Wang and Davis, 1997; Goulart and Melo Filho, 2000).

According to Henning (2005), the aim of a fungicide seed treatment is to destroy, or lower, the inoculum potential of the fungus, which occurs on the seeds or inside them. The objective of the present study was to evaluate the efficiency of different fungicide seed treatments in peas for controlling damping-off by *R. solani* and determine their effects on seed physiological quality.

Material and Methods

The study was carried in experimental field and at the seed laboratory of Embrapa Vegetables in Brasilia-Federal District, from March to June 2008. Mikado cultivar pea seeds produced in 2006 at Embrapa Horticulture were used.

Seed treatment: vegetables seeds were treated with nine fungicides at the dosages recommended for each product (Table 1). Each treatment used 500 g of seeds. Fungicides formulated as dusts (Tolyfluanid, Captan, Pencycuron, Procymidone and Iprodione + Thiram) were diluted in 10 mL of distilled water to give better adherence and uniformity of product coverage on the seeds. The liquid products (Iprodione, Carbendazim, Metalaxyl-M + Fludioxonil and Cardendazim + Thiram) were applied directly to the seeds by placing these in plastic bags, adding the product and mixing for three minutes. Only distilled water was applied to the control. After treatment, seeds were dried at ambient temperatures.

Evaluation of seed physiological quality used:

Germination: four replications of 50 seeds per treatment were used. Seeds were sown on germination paper, moistened with distilled water at the ratio of 2.5 times the weight of the dry paper. Seeds were then set to germinate in a BOD-type oven at 20 °C. Evaluations of the percentage germination were done five and eight days after sowing (Brasil, 2009).

Accelerated aging: 250 seeds of each treatment were distributed uniformly on an aluminium mesh fixed in gerbox-type plastic boxes (11 x 11 x 3.5 cm), containing 40 mL of a saturated NaCl solution (40 g of NaCl / 100 mL of water) in the bottom. The boxes with the seeds were closed and kept at 41 °C for 48 hours in an aging chamber. After this period, the seeds were submitted to the germination test as described previously. Primary root protrusion was evaluated five days after sowing.

Table 1. Fungicides used and their respective dosages recommended by the companies.

Fungicides	Dosage (g or mL.Kg ⁻¹)
Tolyfluanid	2.0
Captan	2.0
Pencycuron	3.0
Iprodione	3.0
Carbendazim	1.0
Metalaxyl-M + Fludioxonil	1.0
Carbendanzim +Thiram	1.0
Procymidone	3.0
Iprodione +Thiram	2.0
Control	-

Electrical conductivity: measured on four replications of 25 seeds for each treatment. Seeds were weighed and immersed in 75 mL of distilled water and kept for 24 hours at 20 °C. The electrical conductivity of the solution was determined using a conductivity meter and the result expressed in $\mu\text{S}\cdot\text{cm}^{-1}\cdot\text{g}^{-1}$ (Vieira and Krzyzanowski, 1999).

Growing and inoculation of Rhizoctonia solani: the following trial was done to evaluate the efficiency of different fungicides to control damping-off caused by *R. solani*:

Pure cultures of the pathogen isolated from pea seedlings were kept in a BDA medium for 72 hours and then excised on to a substrate composed of 2 kg of sorghum seeds previously autoclaved twice for 30 minutes each time. After excision, the substrate remained at ambient temperature for three days and was then kept in a BOD for 10 days at 25 °C, sufficient time for the sorghum to be colonized with *R. solani*. The soil was inoculated at the ratio of 1 g of inoculum to 5 kg of soil. Three days after soil inoculation with the fungus, the treated and untreated seeds were sown in plastic boxes (56 x 35 x 10 cm) containing soil inoculated with *R. solani*. Fifty seeds were sown per box using replications. Treated and untreated seeds were also sown in boxes containing no inoculated soil and the boxes were kept in a green house and watered frequently. Seedling emergence and damping-off was evaluated eight and 15 days after sowing.

The experimental design was completely randomized and

the data were submitted to an analysis of variance with means being compared using the Tukey test at the 5% probability level.

Results and Discussion

Seedling emergence for untreated seeds was 16% and 73% respectively for soils inoculated and no inoculated with *R. solani* (Table 2). With the exception of Captan, there was no statistical difference between the remaining treatments for the no inoculated soil. However, in inoculated soil, the most efficient seed treatments in peas against *R. solani* were: Carbendazim, Pencycuron, Iprodione and Carbendazim + Thiram, differing from the other treatments ($p \leq 0.05$), which did not differ statistically from each other. All the other treatments, with the exception of Metalaxyl-M + Fludioxonil, did not differ from the control (Table 2).

R. solani may cause damping-off in both pre and post emergence but this was only observed in pre-emergence in the present study. The evaluation of the percentage final emergence of seedlings demonstrated fungicide efficiency against *R. solani* attack as well as stand maintenance and avoidance of the damping-off caused by this pathogen in post-emergence. Similar results have been observed with the fungicide treatment of cotton seed (Goulart, 2006; Wang and Davis, 1997; Menten and Paradela, 1996), when emergence increased and seedling damping-off caused by *R. solani* was controlled.

Captan caused phytotoxicity in seeds (visual observation), adversely affecting their germination (Table 3). This phytotoxic, fungicide effect on pea seeds was also observed by Nascimento and Cícero, 1991. However, the remaining treatments did not show significant differences in seed germination.

The Carbendazim + Thiram and Iprodione + Thiram treatments gave a better result for the vigor test, as seen for accelerated aging, but with no significant difference with the control and for most treatments. Lasca et al. (2005) observed that seed treatment with Carbendazim + Thiram gave a satisfactory result for the physiological quality of corn seeds. Seeds treated with Captan and Iprodione, fungicides commonly used to treat pea seeds, showed a statistical difference with those seeds treated with Carbendazim + Thiram and Iprodione + Thiram in the accelerated aging test (Table 3). However, in the first count test, the control gave the best result, together with Metalaxyl-M + Fludioxonil and Iprodione + Thiram, with no differences between them ($p \leq 0.05$). As observed for germination, Captan also adversely affected seed vigor in both tests, corroborating with results from Campos et al. (2009) for papaya seeds, where Captan also adversely affected seed vigor. There were no statistical differences between treatments for the electrical conductivity test in contrast to the results obtained by Nascimento and Cícero (1991) for pea seeds.

Table 2. Seedling emergence for the Mikado pea cultivar seeds treated with different fungicides in no inoculated soil (ES) and in soil inoculated with *R. solani* (ESI).

Treatments	ES (%)	ESI (%)
Tolyfluanid	73 ab*	23 c
Captan	64 b	20 c
Pencycuron	81 ab	74 a
Iprodione	86 a	82 a
Carbendazim	84 ab	74 a
Metalaxyl-M + Fludioxonil	85 ab	49 b
Carbendazim + Thiram	86 a	78 a
Procymidone	78 ab	30 bc
Iprodione + Thiram	75 ab	34 bc
Control	73 ab	16 c
CV(%)	11.2	21.0

*Means followed by the same letter in the column do not differ according to the Tukey test at the 5% probability level.

Table 3. First germination count (GC), germination (G), Mikado accelerated aging (AA) and electrical conductivity (EC) of pea seeds treated with different fungicides.

Treatments	GC (%)	G (%)	AA (%)	EC(/G)
Tolyfluanid	19 d*	86 ab	74 ab	0.0688 a
Captan	19 d	85 b	62 c	0.0742 a
Pencycuron	27 d	87 ab	75 ab	0.0885 a
Iprodione	61 c	95 a	64 bc	0.0675 a
Carbendazim	59 c	91 ab	67 abc	0.0725 a
Metalaxyl-M+ Fludioxonil	74 ab	89 ab	75 ab	0.0735 a
Carbendazim + Thiram	63 bc	93 ab	79 a	0.0812 a
Procymidone	56 c	91 ab	73 abc	0.0750 a
Iprodione + Thiram	74 ab	89 ab	77 a	0.0763 a
Control	87 a	92 ab	73 abc	0.0742 a
CV(%)	9.83	4.4	6.8	12.0

*Means followed by the same letter in the column do not differ according to the Tukey test at the 5% probability level.

Conclusions

The most efficient fungicides for *Rhizoctonia solani* control were Carbendazim, Pencycuron, Iprodione and Carbendazim + Thiram. The fungicides Carbendazim + Thiram, Iprodione + Thiram and Metalaxyl-M + Fludioxonil gave the best results for seed vigor.

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