

**UNIVERSIDADE FEDERAL DE PELOTAS**  
**Faculdade de Agronomia Eliseu Maciel**  
**Programa de Pós-Graduação em Fitossanidade**



Tese

**Rapid reduction of herbicide susceptibility on *Echinochloa colona* by recurrent selection with sublethal dose of herbicides and abiotic stress**

**Lariza Benedetti**

Pelotas, 2019

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Tese apresentada ao Programa de Pós-Graduação em Fitossanidade da Universidade Federal de Pelotas, como requisito parcial à obtenção do título de Doutor em Fitossanidade (área do conhecimento: Herbologia).

Orientador: PhD Luis Antonio de Avila

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Para minha Família e Amigos

**Eu ofereço e dedico**

Do not let the day end without having grown a bit, without being happy,  
without having risen your dreams.  
Do not let overcome by disappointment.  
Do not let anyone you remove the right to express yourself,  
which is almost a duty.  
Do not forsake the yearning to make your life something special.  
Be sure to believe that words and poetry it can change the world.  
Whatever happens, our essence is intact.  
We are beings full of passion. Life is desert and oasis.  
We breakdowns, hurts us, teaches us, makes us protagonists of our own history.  
Although the wind blow against the powerful work continues:  
You can make a stanza. Never stop dreaming, because in a dream, man is free.  
Do not fall into the worst mistakes: the silence.  
Most live in a dreadful silence. Do not resign escape.  
Rate the beauty of the simple things.  
You can make beautiful poetry on little things, but we can not row against ourselves.  
That transforms life into hell.  
Enjoy the panic that leads you have life ahead. Live intensely, without mediocrity.  
Think that you are the future and facing the task with pride and without fear.  
Learn from those who can teach you.  
Do not let life pass you live without that.

**Carpe Diem- Walt Whitman**

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**ARTIGO 1 – Agronomy (MDPI): Special issue "Implications of Climate Change for Weed Evolution and Herbicide Efficacy"**

**Rapid reduction of herbicide susceptibility in junglerice by recurrent selection with sublethal dose of herbicides and heat stress**

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**Abstract**

The global climate change, specifically rising temperature, can alter the molecular physiology of weedy plants. These changes affect herbicide efficacy and weed management. This research aimed to investigate the combined effect of heat stress (HS) and sublethal dose of herbicides (four active ingredients) on adaptive gene expression and herbicide efficacy on *Echinochloa colona* (junglerice). Three factors were evaluated; factor A was *E. colona* generation (G0-original population SS; G1 and G2 were progenies of recurrent selection), factor B was herbicide treatment (florpyrauxifen-benzyl, glufosinate-ammonium, imazethapyr, quinclorac and nontreated check); and factor C was HS (30 and 45 °C). The herbicides were applied at 0.125x the recommended dose. Recurrent exposure to HS, combined with sublethal dose of herbicides, favors the selection of plants less susceptible to the herbicide. Upregulation of defense (antioxidant) genes (*APX*: *Ascorbate peroxidase*), herbicide detoxification genes (*CYP450 family*: *Cytochrome P450*), stress acclimation genes (*HSP*: *Heat shock protein*, *TPP*: *Trehalose phosphate phosphatase* and *TPS*: *Trehalose phosphate synthase*), and genes related to herbicide conjugation (*UGT*: *UDP Glucosyltransferase*) was significant. The positive regulation of these genes may promote increased tolerance of *E. colona* to these herbicides.

**Keywords:** *Echinochloa colona*, climate change, high temperature, low dose, weed resistance evolution, susceptibility, transcriptome.