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Application of herbicides on parental lines (A clearfield® and R) of hybrid rice at post-flowering stage for production

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Abstract

The hypothesis of this study is based on the fact that parental line A-Clearfield® (male-sterile genotype) (Clearfield provide has tolerance to imidazolinone herbicides) and line R (male-fertile genotype - pollinator) is sensitive to the herbicide. So after flowering, we may apply an imidazolinone herbicide (Kifix®) to the plantings to kill line R, and harvesting only the hybrid seeds. The objective was to test the use of imidazolinone herbicide on parental lines (A-Clearfield® which is resistant to Kifix herbicide) and R no Clearfield® (non-resistant to Kifix genotype) as a strategy to improve production of hybrid seed in rice. Two trials were conducted to evaluate (A) the use of doses of imidazolinone herbicide in line R (plant control, number of grains per panicles, grain yield and seed germination; and (B) the use of different doses of imidazolinone herbicide in line A Clearfield® grain yield and seed germination. Trials were conducted in the tropical region of Brazil in randomized complete block design in factorial scheme 5 x 2 x 2. The treatments were the combination of five Kifix (Imazapyr, 525 g kg^{-1} + Imazapic, 175 g kg^{-1}) rates applied on two no Clearfield® rice genotypes (first trial) or Clearfield® rice genotypes (second trial) in two growing seasons. The results showed application of herbicide doses higher than 150 g ha^{-1} after full flowering stage can cause reduction in growth and development of no Clearfield® rice. The use of Kifix herbicide in CL (Clearfield®) rice cultivars did not affect the grain yield, mass of 1000 grains, seed germination, first count germination, seedling emergence and seedling length. New researches should be done to define plant arrangement suitable for line R (no Clearfield®) and line A Clearfield® to find the optimum condition to produce hybrid seeds. From our results, we could see that the use of parental line A Clearfield® with a line R no Clearfield®, after flowering, provided the production of only hybrid seeds in the area, without reduction in seed quality.

Keywords: *Oryza sativa*, agronomic strategies, Kifix, imidazolinone.
Abbreviation: CL_Clearfield; ALAM_Asociation Latinoamericana de Malezas.

Introduction

Rice is a staple food for more than half of world population (Tesio et al., 2014; Nascente et al., 2013; Prasad, 2011). There is an increasing demand of rice worldwide. It is expected that more than 116 million additional metric tons will be required in the year 2035 compared with the world rice production in 2010 (GRiSP, 2013). Therefore, the development of technologies that result in a higher rice grain yield is necessary to meet this demand and feed the world (Akhter et al., 2007; Qin et al., 2013). Globally and especially in Asian countries, the use of hybrid rice has achieved a significant increase in the grain yield compared with the use of traditional cultivars (Tan et al., 2002). According to Ravi et al. (2007), Krishnakumar et al. (2005) and Virmani (2003) in countries such as China and India, the use of hybrid rice raised the average grain yield by 15-30% compared with traditional methods. These countries are the world's largest producers of rice and their cultivation of hybrid rice is widespread and has been used by farmers for more than 20 years (Kim et al., 2007; Mondo et al., 2016). These increases in rice grain yield represent, on average, an increase in productivity from 10,000 kg to 13,000 kg ha^{-1}.

To enable the production of hybrid rice seeds, it is important to have cytoplasmic male sterility, which allows outcrossing between the different plants. It is also vital to have a genetic system that restores male fertility (restorer) (Shahid et al., 2013; Huang et al., 2013; Tesio et al., 2014). The production of hybrid rice seeds requires a system composed of three lines: male-sterile (line A), male-fertile with the ability to maintain sterility of the line A (line B) and another, also male-fertile, with the restoring capacity for fertility in line A (line R). The combination of the first two lines (A and B) produces seeds that originate from male-sterile plants (line A seeds). The cross between A and R lines produces hybrid seeds originating from fertile plants (Bragantini et al., 2001).