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Evaluation of intragenic sugarcane with a point mutation in the acetolactate synthase gene for resistance level and cross-resistance pattern to ALS-inhibiting herbicides

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Weed control in sugarcane is problematic due to low natural tolerance to herbicides with broad spectrum, high efficiency and favorable toxicological profile. The recent derived intragenic and cisgenic biotechnological approaches provide the improvement of crop traits similarly to conventional plant breeding by using genes and regulatory elements from the same or similar species. The objective of this study was to evaluate the level of resistance and the herbicide cross-resistant pattern in intragenic-derived ALS-resistant sugarcane. Several lines were developed by biolistic gene transfer of a cassette encoding an ALS gene from sorghum with a mutation at the position Trp574 under control of the sorghum ubiquitin promoter and sorghum HSP 3'UTR. Following direct embryogenesis and regeneration of plants on culture media containing bispyribac-sodium herbicide as a selection agent, vegetative progenies were generated for detailed analysis of resistance against a range of herbicides under greenhouse conditions. The level of resistance was evaluated for the herbicides nicosulfuron, imazapyr and bispyribac-sodium applied at rates from zero, 1, 2, 5 and 10 X the recommended rates. The treatments for the cross-resistance study were nicosulfuron, clorsulfuron, imazapyr, bispyribac-sodium, flumetsulan and flucarbazone applied at zero and 2 X the recommended rates. The evaluations consisted of visual injury at 10, 20 and 30 days after treatment (DAT), aboveground dry weight at 30 DAT, and plant high of regrowth after harvest. The resistant factor (RF) based on aboveground dry weight at 30 DAT for the herbicides nicosulfuron, imazapyr and bispyribac-sodium varied from 6.21 to 11.81, 3.49 to 5.35 and 5.07 to 7.52, respectively. The RF was higher in the line A3R for all herbicides, and was lower in the line H10 for nicosulfuron and imazapyr and in H4 for bispyribac-sodium. All lines were resistant to the herbicides from all five classes of ALS-inhibitors. The visual injury and plant high of regrowth after cutting followed the same pattern of results as the aboveground dry weight. The intragenic selection system was efficient to deliver sugarcane lines with high level of resistance and broad cross-resistance to all classes of ALS-inhibiting herbicides.

Palavras-chave: ALS gene, herbicide resistance, mutation Trp574, plant transformation