CLEARFIELD® RICE GENOTYPES TOLERANCE TO AERIAL APPLICATION OF IMIDAZOLINONES AS AFFECTED BY PLANT DENSITY

Rafael Becker[1]; Edinalvo Rabaioli Camargo[2]; Alfran Tellechea Martini[3]; Luis Antonio de Avila[2]; Luiz Fernando Martini[4]; Cédrick Benetti[5]; Marcelo Zimmer[6].

Keywords: herbicide application technology, electrostatic spraying system, crop injury.

INTRODUCTION

Aerial application of herbicides is a common operational practice in irrigated rice (*Oryza sativa)* production of Southern Brazil. The state of Rio Grande do Sul harvested 1,125.4 millions hectares during the 2014/15 rice season. The production in this area was estimated to be around 8,112.9 million ton, which represents 67% of the entire country's production (CONAB, 2015).

As in other crops, weeds are a major limiting factor for rice production, and new technologies are important to improve the weed management. Use of electrostatic system is increasing with aerial application and it may result in different herbicidal activity. For instance, in the electrostatic system charged droplets tend to promote a better plant coverage.

The Clearfield® rice are nontransgenic genotypes developed with traditional plant-breeding techniques that allows of imidazolinone herbicide . This tolerance was obtained by induced mutation, and transferred to commercial cultivars and hybrids through genetic improvement of plants. After imidazolinone herbicide applications, phytotoxicity symptoms, moderate to relatively high, can be observed in rice plants. These injury effects can be affected by the amount of herbicide that reachs the individual plant. Considering the options of Clearfield® hybrids and cultivars commercially available is important to verify their tolerance to imidazolinone herbicides sprayed with the eletrostatic aerial spraying system.

The present study was conducted to investigate the tolerance of Clearfield® rice genotypes established at different seeding rates and sprayed by electrostatic spraying system

MATERIAL AND METHODS

The experiment was conducted at "Granja 4 Irmãos", a farm located in Rio Grande, RS – Brazil (latitude S 32˚18'01.76", longitude W 52˚29'45.05" and 8 meters above sea level) during the growing season of 2013/2014 in partnership with "Taim Aero Agrícola". Treatments were arranged in a factorial scheme (5x2) with four replications. Factor A consisted in five rice genotypes, including two Clearfield® cultivars (Puitá Inta CL and Guri CL) and three Clearfield® hybrids (QM 1010 CL, Avaxi CL and Inov CL). Factor B included two seeding densities (45 and 100 kg ha^{-1}). Seeding rates were used to establish similar plants populations for cultivar and hybrids.

All treatments were sprayed twice with the herbicide Only® (0.75 L.ha^{-1}) and adjuvant

[1] Graduação Engenharia Agronômica, Faculdade de Agronomia Eliseu Maciel - FAEM, Universidade Federal de Pelotas-UFPel, rafa_becker23@hotmail.com.
[2] Professor Ph. D., Universidade Federal de Pelotas - UFPel.
[3] Engenheiro Agrônomo, Mestre, Universidade Federal de Santa Maria - UFSM.
[4] Engenheiro Agrônomo, Doutor, Dow Agrosciences.
[5] Graduação Engenharia Agronômica, FAEM, Universidade Federal de Pelotas - UFPel.
[6] Engenheiro Agrônomo, Purdue University.

Dash® (first at pre-emergence of the crop where glyphosate (3 L ha^{-1}) was included and then at V4 growth stage). Check treatments were set up inside each plot for comparison in phytotoxicity evaluations based on percentage scale and consisted of a portions of the plot protected with white plastic covers (4m x 2m) that was removed only after all spraying was performed. Injury as assessed visually from zero to 100%, where zero corresponds to the absence of herbicide injury and 100% is total death of all plants in the plot due to herbicide injury (Gazziero et al., 1995).

Crop conduction was performed according the Southern Brazil Rice Production Guidelines (SOSBAI, 2014). Weed management on check treatments consisted of spraying of Clincher® (1,5 L ha-1) and Sonora® (0,140 L ha^{-1}) with CO^2 backpack sprayer. Four plants of each replication were collected immediately after spraying on V4 growth stage for the two seeding densities on Puitá INTA CL variety to determine concentration of the herbicide deposited on the plants. These samples were placed inside amber vials containing 0.05 L of acetonitrile and then shaken for 15 seconds for every replication. Plants were taken out of the vials and the solutions were stored under refrigeration and subsequentely were sent to the "Laboratório de Resíduos de Pesticidas – LARP" of the Federal University of Santa Maria (UFSM) for analysis. Pesticide determination was performed using a system of liquid chromatography along with a mass spectrophotometry (UHPLC-MS/MS). Limit of detection (LOD) was 1.5 µg L^{-1} and a limit of quantification (LOQ) was 5.0 µg L^{-1} in the method.

Aerial spraying of the trial was performed aligned with the prevailing wind, differing from the planting direction to reduce herbicide loss, drift and avoid contamination of other plots. Also, all spraying was performed in the same direction to reduce variation on airplane speed. The airplane used was an Ipanema EMB-202, 1800 kg weight, 7.43 meters long, 2.22 meters in height and 11.07 meters wingspan, with a spraying bar installed measuring 70% of the total wingspan. It was equipped with DGPS Satloc-M3®, wing tip winglet type, and a wind pump. Airplane flew at 176 Km h^{-1}, 2 meters above the target and the application lane adjusted to 15 meters. The airplane was equipped with 41 Teejet TXVK 10 nozzles, 180˚ angle, set for thin water flow with 500 kPa system pressure to perform the application. On preemergence application, the left bar was set for 3.000 volts and the drops were negatively charged, while the right bar charged the drops positively with an amperage of 300 µA. On V4 growth stage spraying, the left bar used 7.800 volts and the drops generated were negatively charged, while the right spraying bar was set to 5.500 volts and the drops were positively charged and with amperage of 500 µA. Weather conditions were monitored during all application timing using a handheld weather station Kestrel 4000®. During preemergence application air temperature was 21.5˚C, air relative humidity of 80% and 20 km h^{-1} wind speed. On V4 spraying, air temperature was 19.2˚C, air relative humidity of 70% and 20 km h^{-1} wind speed.

RESULTS AND DISCUSSION

Rice injury evaluations conducted 9 and 23 days after POST applications (DAA) (Figure 1) indicated that at lower seeding quantities (45 kg ha^{-1}) plant injury was higher compared with the highest seeding rates (90 kg ha^{-1}). This was in agreement with a numerically higher herbicide concentration reaching individual plants of Puitá Inta CL at 45 kg ha^{-1} when compared with 90 kg ha^{-1}.

The cultivars (Puitá Inta CL and Guri Inta CL) demonstrated injury lower that 6% at all evaluations performed indicating to be the most tolerant to Only®. The hybrid Inov CL presented the highest injury at 9 DAA followed by Avaxi CL and QM-1010 CL. This last genotype had injury similar to the cultivars at this earlier evaluation. Subsequent evaluation at 23 DAA indicated that all hybrids had similar injury varying from 23 to 27%. In later evaluation (30 DAA) injury had diminished for all rice genotypes.

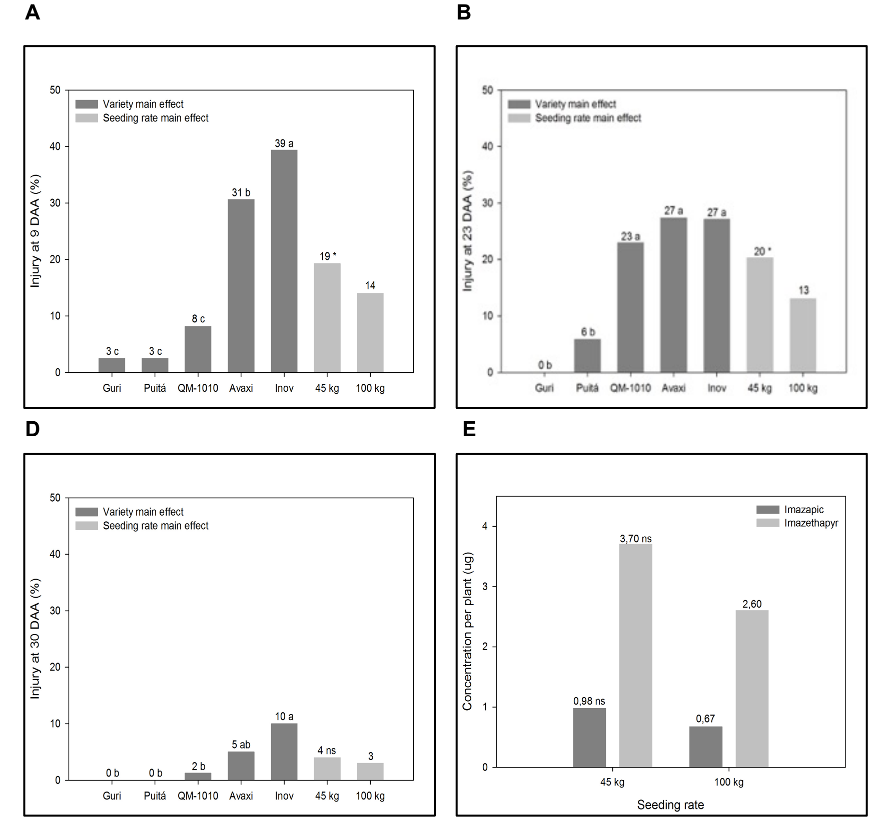

Figure 1. Rice genotypes injury at 9 (A), 23 (B) and 30 (C) days after application (DAA) and imazapic and imazethapyr concentrations as a factor of seeding rates (D).

CONCLUSIONS

Results indicated that different level of genotypes tolerance observed in the field are associated with genetic differences where the cultivars (Puitá Inta CL and Guri Inta CL) were more tolerant to Only® than the hybrids (QM 1010 CL, Avaxi CL e Inov CL). Moreover, the lower quantity of plant per area established in the field when using a rice hybrid may result in a higher dosage of herbicide per individual plant that could contribute for a more intensify crop injury.

ACKNOWLEDGEMENTS

We thank Granja 4 irmãos and Taim Aero Agrícola for their great support conducting the study and for the valuable research partnership. Also, we thank all the students associated with the Weed Science Center/Herbicide E-fate Laboratory at UFPel for their support and help.

REFERENCES

GAZZIERO, D.L.P.; VELINI, E.D.; OSIPE, R. **Procedimentos para instalação, avaliação e análise de experimentos com herbicidas**. Londrina: Sociedade Brasileira da Ciência de Plantas Daninhas, 1995. 42p.

CONAB. Companhia Nacional de Abastecimento. **Acompanhamento da safra brasileira de grãos**. ISSN 2318-6852, numero 3, volume 2, Brasilia, 105 pg., dez. 2014.

SOCIEDADE SUL-BRASILEIRA DE ARROZ IRRIGADO - SOSBAI. **Arroz irrigado**: Recomendações Técnicas da Pesquisa para o Sul do Brasil. Santa Maria, RS, 2014. 192p.