17th European Weed Research Society Symposium
Montpellier – 22-26 June 2015

What is the status of rice systems in Uruguay in terms of herbicide resistance?

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Rice production systems in Uruguay have been characterized by rotations with pastures, low inputs and very high yields. Nevertheless, land use changes have led to more crop-intense rotations, reducing the pasture phase in a large area. Intensification results on an augment in herbicide use, which is well known, along with reducing crop rotation, as major drivers in the evolution of herbicide resistant weeds.

Barnyardgrass (*Echinochloa* spp.; ECH) is the foremost weed in rice systems, and it has to be heavily controlled in order to get good yields. Various herbicides in sequences -pre and post emergence- and tank mixes are used. Currently the number of applications and herbicide doses has been raised in order to obtain acceptable controls. In addition, a recent study carried on with *Echinochloa crus-galli* (L.) Beauv from the East side of the country detected various biotypes resistant to quinclorac (Saldain and Sosa, 2013). However, it remains unknown if this is a widespread problem at farm level in other regions.

OBJECTIVE: to evaluate the status of rice systems in northern Uruguay in terms of the presence of resistant *Echinochloa* spp.

Echinochloa crus-galli var. *mitis*

Echinochloa crus-galli var. *crus-galli*

Echinochloa colona

METHODS

Geo-referenced ECH samples from rice fields within the center and north of Uruguay started to be collected in summer 2013, including spots where farmers suspected of having a resistance issue. Following the Herbicide Resistance Action Committee (http://hracglobal.com/) protocols, dose response assays were conducted with some of the herbicides used in post emergence in current Uruguayan rice production, as quinclorac, propanil and imidazolinones.

Eight doses of each herbicide was used in four replicates and two experiments per biotype, being "Dose 1" equivalent to the field rate; 0,125, 0,25, 0,5, 2, 4 and 8 times "dose 1" and a "control" –Dose 0- completed the set. Pots with 5 plants were cultivated for 21 days during the summer under a mesh house, in flooded conditions. Fresh weight per pot was analyzed using the *drc* package (Ritz and Streibig, 2012) in R (http://www.r-project.org/). Resistance factors were calculated as the relation between the ED50 of each biotype vs ED50 the most susceptible one.

RESULTS

All ECH tested were resistant to quinclorac (Table 1), with some cases where the RF could not be calculated due to the higher dose tested –eight times the field rate- could not reduce fresh weight.

No resistance was read on the evaluations with propanil (data not showed). Nevertheless, some biotypes had a RF about 6-7 whereas the "S" ED50 corresponded to 173 g ai.ha^{-1} (a quarter of the field rate).

Table 1. Resistance factors obtained for quinclorac in *E. crus-galli*. Susceptible biotype (A33P2) has an ED50 = 25 g ia.ha^{-1}

Biotypes	Resistance Factor	St. Error	p-value
SJU1	11	3.9	0.013
TAP5	59	19.8	0.004
TEP12	21	9.3	0.037
TSF7	(1)	NA	NA
ATA3	15	5.7	0.012
SPI2	10	3.6	0.018
TAP5	225	83.2	0.007
TEV10	1909	850	0.025
TLL6	15720	7507	0.037
TVA8	75	34.8	0.034
TAP4	(1)	NA	NA
ARI11	(1)	NA	NA
TEV9	(1)	NA	NA

(1) Resisted the maximum rate used, more than 8 times the field rate.

When tested with imidazolinones (imazapyr + imazapic), only one biotype showed a RF >10 (Figure 1); it was collected from a field where the Clearfield technology have been used. This should aware us about the risks of using technology that base its efficacy on an ALS inhibitor, the easiest resistance-evolving herbicide group.

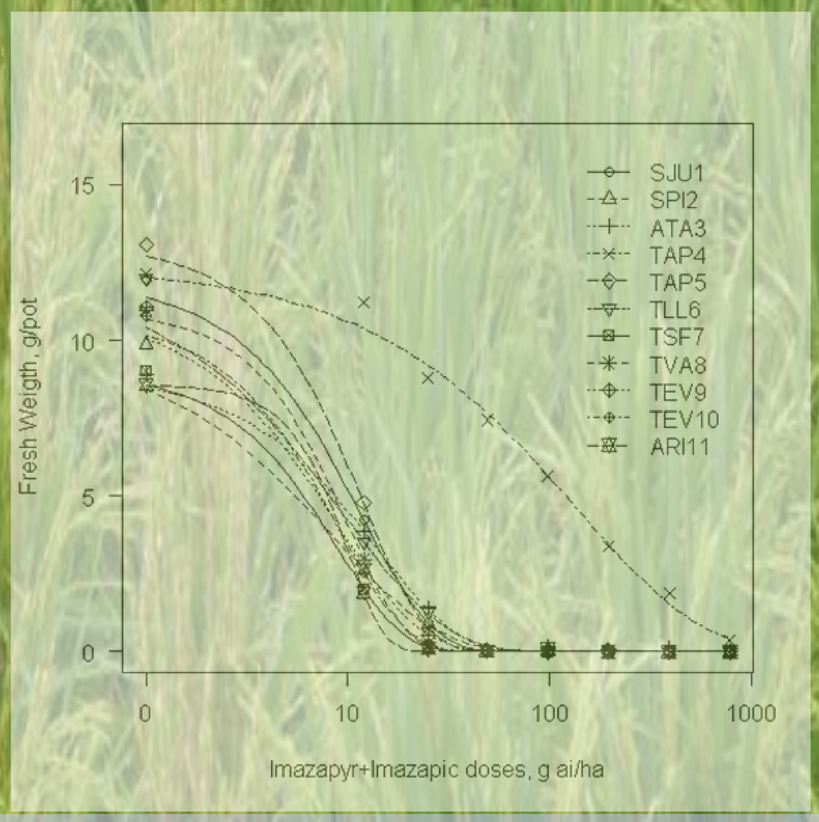

Figure 1. Fresh weight of *E. crus-galli* biotypes when exposed to increasing doses of imidazolinones.

Despite uruguayan rice systems still includes an important area of rotation with pastures, the presence of resistant biotypes are in agreement with the intensification production context farmers are experiencing nowadays.

We need to confirm our results on an even widespread scale and keep on working more on extension to awareness farmers and industry in order to slow down the evolution of resistant weeds. Tests with *E. colona* and E. *crus-galli* var. *mitis* collected from the same fields are still remaining, as well as assays with other herbicides. At the same time data from field's management history is being collected in order to understand why resistance has or has not evolved.

CONCLUSIONS

After evaluating a few rice systems from northern Uruguay, some ECH herbicide resistance biotypes -to quinclorac and imidazolinones- have been detected.

REFERENCES

Saldain, N. and Sosa, B. 2013. Quinclorac and Propanil resistant-Barnyardgrass biotypes (*Echinochloa crusgalli*) in rice fields of eastern Uruguay, GHRCC, Australia.