Controlling *Echinochloa* spp. with herbicides in an integrated management system: results and new challenges.

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INTRODUCTION

Rice production systems in Uruguay include an important area of rotation with pastures for beef production. Alternating rice crops with pastures as well as summer tillage and levees construction the year before planting could improve various aspects of rice management, including IWM. Being Barnyardgrass (*E. crus-galli*, BYG) the most important weed in rice systems, less BYG presence would be expected when rotations are accomplished.

Mechanical control through summer tillage, grazing, alternate rice crops and the inclusion of a biannual pasture, are all strategies that mitigate weed infestations, if well managed. Nevertheless, BYG keeps on being the main target in weed control programs, due to the enormous yield losses it causes. On the other hand we are aware about the fact that continuous use of similar herbicides increase selection pressure leading to the evolution of herbicide resistance. Exploring various options under different agro ecosystems brings tools to help in preventing this problem.

OBJECTIVE: to evaluate chemical options for better control of BYG in rice - pasture systems in Uruguay, under conventional and alternative levees and water management.

METHODOLOGY

Herbicide trials were installed during three years in fields under rice-pasture rotation systems in two regions (C: center and N: north). Between 14 - 16 herbicide mixes and sequences were tested over BYG, evaluating weed control and rice yield. Herbicides used are listed on Table 1.

Experimental design corresponded to randomized complete blocks with three replicates and data was processed using Infostat (www.infostat.com.ar).

Weed control was evaluated counting BYG plants per area (and tiller or leaves number) on early rice stages, and by using a visual score scale when crop was tall (1: No control, 2: 25%, 3: 50%, 4: 75% and 5: total control). Rice yield was estimated harvesting a 5 m^{-2} area on each plot.

Table 1. List of herbicides used, denoting common name, active ingredient concentration and classification by family or mode of action (according to HRAC*).

Common Name	a.i. (gr.kg^{-1} o gr.l^{-1})	Mode of action
Clomazone	480	Inhibition of pigment synthesis (F)
Propanil	480	Inhibition of photosynthesis at PSII (C)
Quinclorac	250	Synthetic auxins (O)
Profoxidim	205	Lipid synthesis inhibitor – inhibition of ACC-ase (A)
Bispyribac	400	Inhibitor of ALS –branched chain amino acid synthesis (B)
Penoxsulam	240	Inhibitor of ALS –branched chain amino acid synthesis (B)

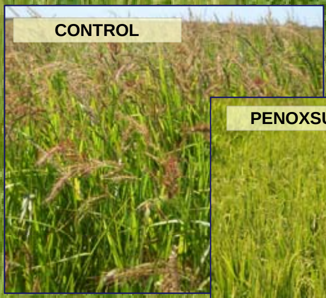
*HRAC: Herbicide Resistance Action Committee, http://www.hracglobal.com.

RESULTS and DISCUSSION

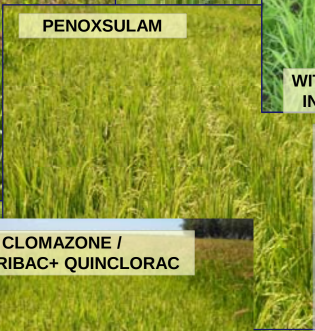
Many tested options succeeded in both sites, reaching excellent rice productivities (more than 10 tons ha^{-1}) as well as weed-free plots at flowering and harvest, important issue to reduce posterior infestations in the system (Table 2). In Site C, penoxsulam (0.04 kg.ha^{-1}) was the best treatment, with or without clomazone (0.384 kg.ha^{-1} at pre-emergence), whereas in Site N, tank mix of bispyribac (0.04 kg.ha^{-1}) plus quinclorac (0.3 kg.ha^{-1}) had best results. The use of clomazone pre-emergence was almost inevitable for good results in Site C in some years, where infestations were really high (control plot yield about 300 kg.ha^{-1}). Excellent outcomes were also found with graminicidas as profoxidim, although it showed phytotoxicity over the tested cultivar (indica type).

Table 2. Rice yield (kg.ha^{-1}) and BYG control (at rice flowering) in two sites, Center (C) and North (N) of Uruguay, with some herbicide mixes or sequences tested.

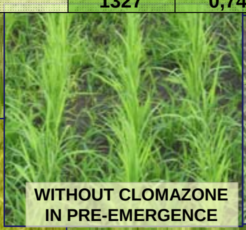
Application time		Dosis	N-Yield	N- BYG control	C-Yield	C- BYG control
Pre-emergence	Post-emergence	gr a.i/ha	Kg/ha	(flowering)	Kg/ha	(flowering)
Clomazone	Bispiribac + Quinclorac	0,48 + 0,04 + 0,3	12257 a	5 a	12474 a	4,5 ab
Clomazone	Propanil + Quinclorac	0,48 + 1,4 + 0,3	12054 ab	4 bc	11115 abc	4 b
Clomazone	Profoxidim	0,48 + 0,14	11901 abc	4,5 ab	11003 abc	5 a
	Penoxsulam	0,04	11212 abc	4,5 ab	12474 a	5 a
	Bispiribac + Quinclorac	0,04 + 0,38	11156 abc	4,5 ab	8179 de	3 c
	Propanil + Quinclorac + Clomazone	1,9 + 0,38 + 0,38	11107 abc	4,3 ab	10334 bc	4,5 ab
Clomazone	Penoxsulam	0,48 + 0,04	10798 bc	4,7 ab	11561 abc	5 a
Clomazone		0,58	9106 d	2,7 ef	7567 e	2,5 c
Control			6752 e	1,5 f	300 g	1 d
Mean			10859	3,8	9219	3,8
CV %			7,3	11,4	10	11
Treatments sign.			<0,0001	< 0,0001	< 0,0001	< 0,0001
LSD Fisher 0,05			1327	0,74	1652	0,7



CONTROL



PENOXSULAM



WITHOUT CLOMAZONE IN PRE-EMERGENCE

WITH CLOMAZONE IN PRE-EMERGENCE

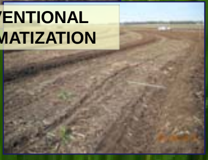
Attending to reach higher water use efficiency, new irrigation and systematization methods had exposed new challenges on weed control. In high-pendant topographies where levees percent area is elevated, lower and smaller levees are built to increase rice production on them. More levees could imply more not-well irrigated area; on the other hand, lower levees would improve wetting.

CLOMAZONE / BISPYRIBAC+ QUINCLORAC

Moreover, intermittent irrigation (alternate wetting and drying) could reduce herbicide efficiency, increasing weed infestations and risks of evolution of resistance (through sub-doses and escapes).

PROFOXIDIM + QUINCLORAC

ALTERNATIVE SISTEMATIZATION



CONVENTIONAL SISTEMATIZATION

CONSIDERATIONS

Many good options are available to control BYG in a sustainable way in rice-pastures systems of Uruguay, preventing important yield losses and evolution of resistance. Nevertheless, alternative production systems are imposing new challenges that research is obliged to addressed in the short term.