Instituto Nacional de
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Resistance Risk Assessment For ALS Inhibiting Herbicides In Rice Weeds

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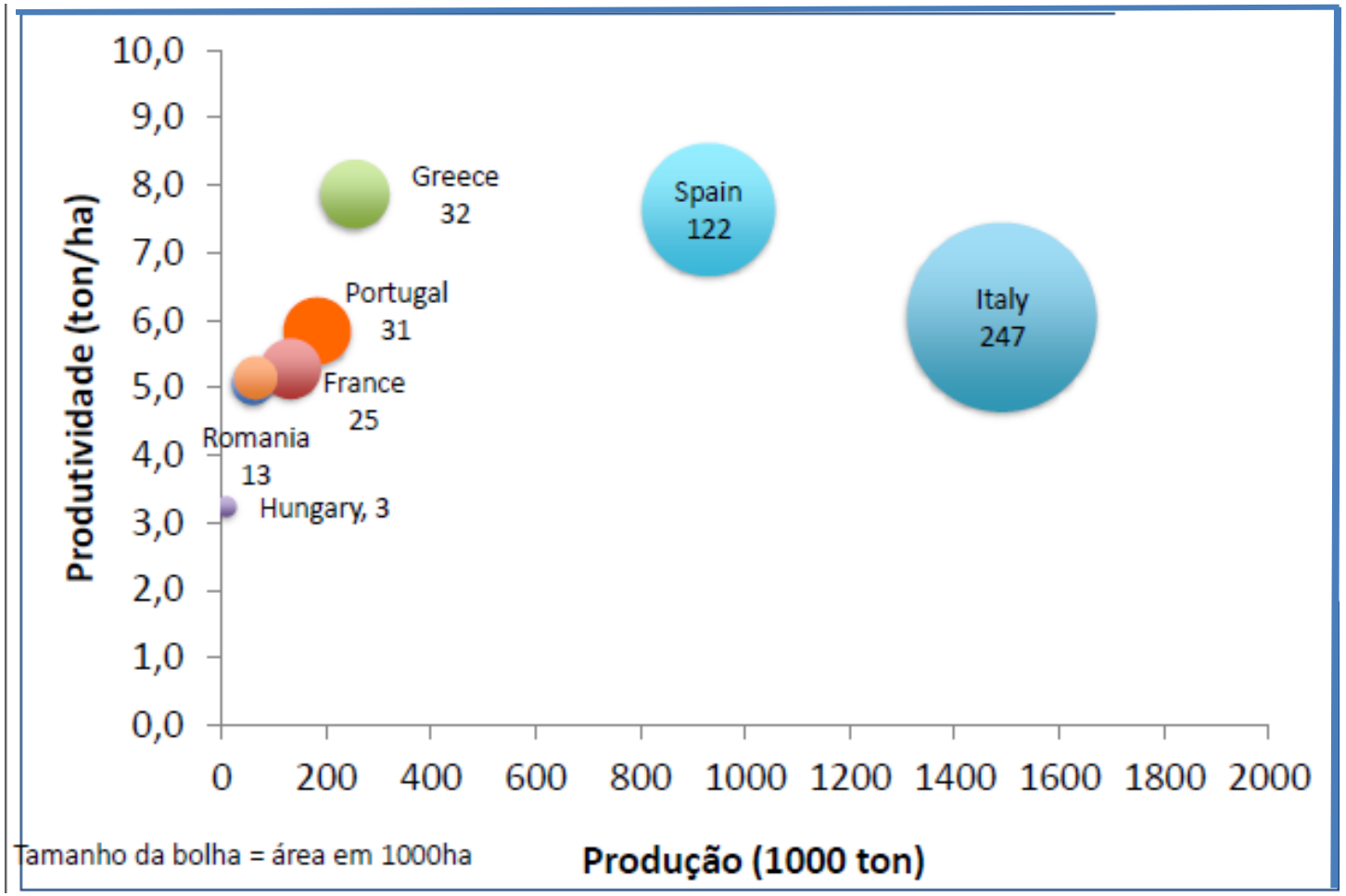
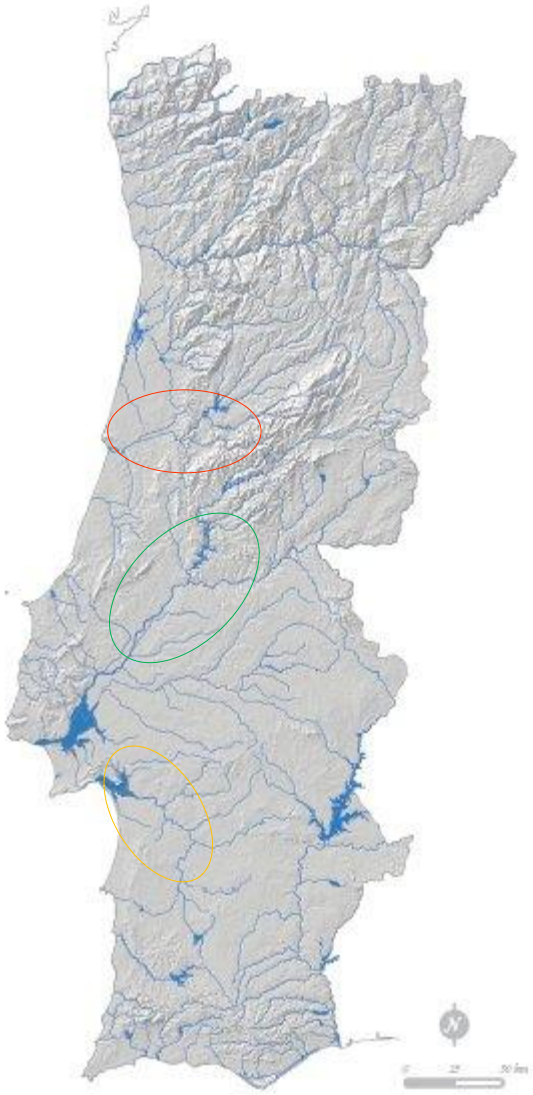
Produtivity rice -Portugal



PT Average Produtivity **6,2 t / ha**

Main rice areas

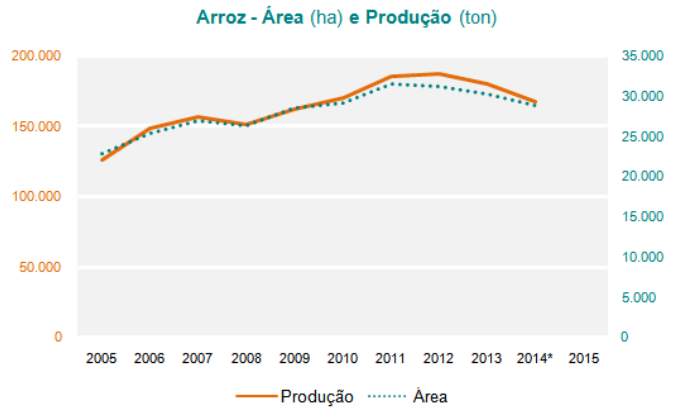


GPP (2006)

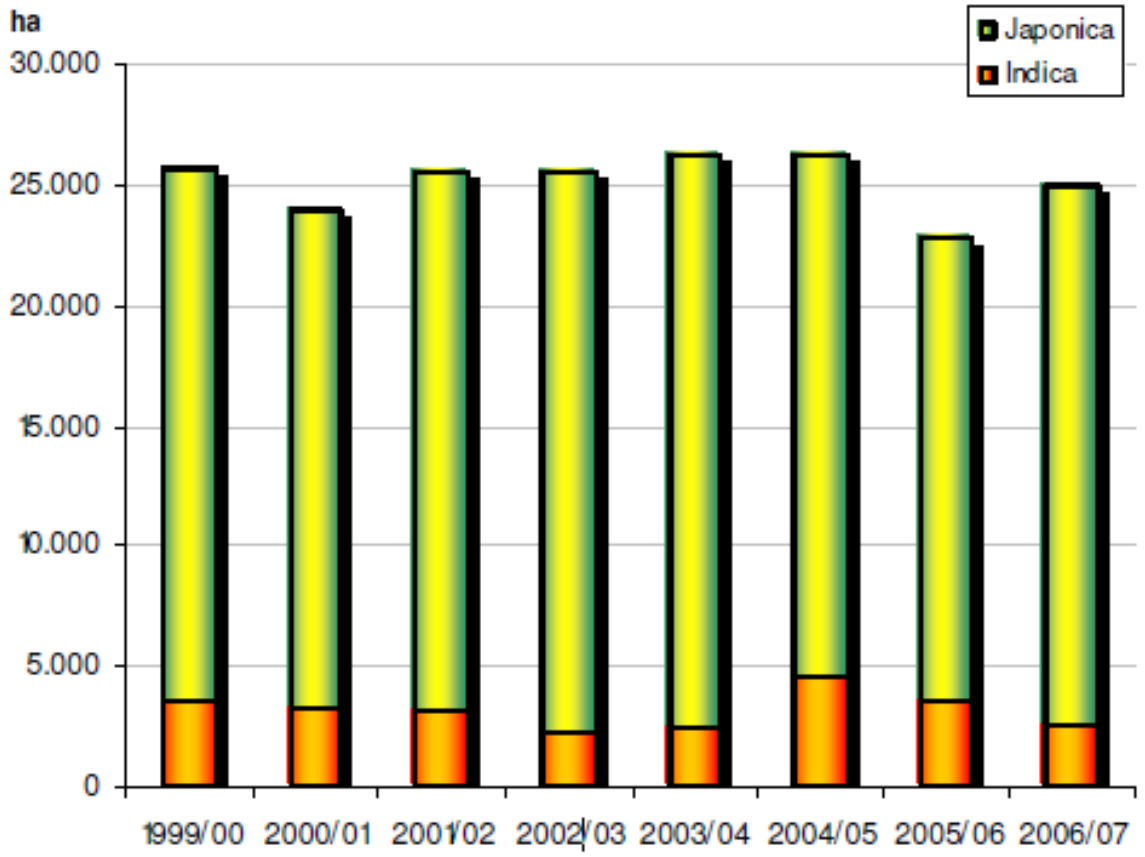
Beira Litoral (BH Mondego)
6 000 ha

Ribatejo (BH Tejo e Sorraia)
14 300 ha

Alentejo (BH Sado)
9 000 ha



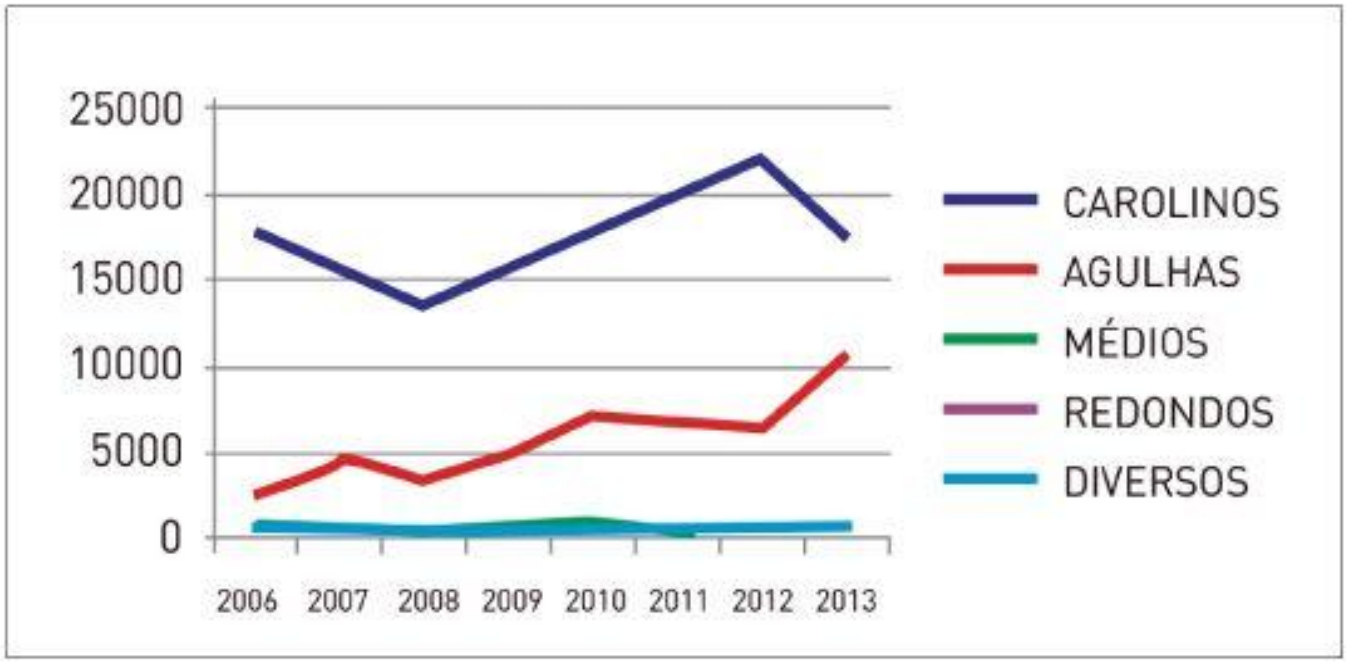
Área per rice type (ha)



Fonte: INE/INGA

Consumption by type of rice

PT Consumption per capita 17 kg / ano



Sevinate Pinto (2015)

Weeds are major phytossanitary problems in rice

Main rice weed in Portugal

40 - 45 species

Cyperacea, Poaceae









Alismataceae




Pontederiaceae - *Heteranthera spp.*

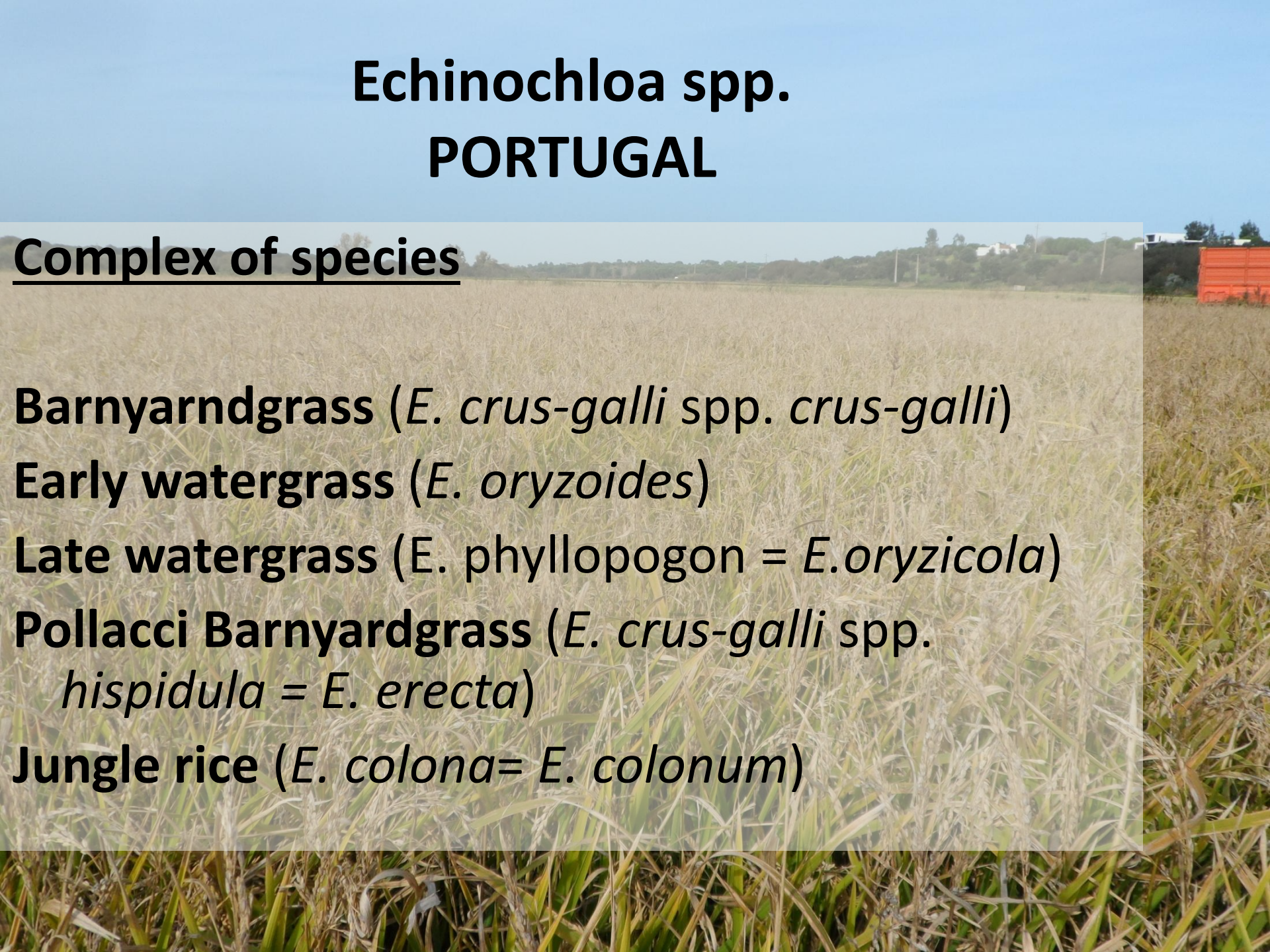
Dycotiledones


Weed survey – 100 rice fields – Tagus and Sorraia RB

Species	Espécie	EPPO Code	Abundance	Fr
Alismataceae	Alisma plantago-aquatica L.	ALSPA	3,7	31
Cyperaceae	Cyperus difformis L.	CYPDI	8,7	30
	Cyperus rotundus L.	CYPRO	11,5	1
	Schoenoplectus mucronatus (L.) Palla	SCPMU	6,0	8
Lythraceae	Ammania coccinea Rottb.	AMMCO	1,3	11
Poaceae	Oryza sativa L.	ORYSA	8,8	64
	Leptochloa fusca (L.) Kunth subsp. fascicularis (Lam.) N. Snow	LEFFA	4,4	25
	Echinochloa crus-galli subsp. hispidula (Retz.) Honda	ECHHI	9,7	31
	Echinochloa crus-galli (L.) P. Beauv subsp. crus-galli	ECHCG	6,0	2
	Echinochloa phyllopogon (Stapf.) Koss.	ECHPH	12	55
	Eragrostis pillosa (L.) P. Beauv.	ERAPI	11,5	2
	Glyceria declinata Bréb.	GLYDE	0,5	1
	Paspalum dilatatum Poir.	PASDI	35,5	1
	Paspalum paspalodes (Michx.) Scribner	PASDS	6,5	12
	Digitaria sanguinalis (L.) Scop.	DIGSA	4,2	3
Polygonaceae	Polygonum persicaria L.	POLPE	0,5	2
	Polygonum lapathifolium L.	POLLA	0,8	4
Pontederiaceae	Hetherantera reniformis Ruiz & Pavon	HETRE	12,5	24
	Heteranthera limosa (Sw.) Willd.	HETLI	9,6	13
	Heteranthera rotundifólia (Kunth) Griseb.	HETRO	0,5	2
Typhaceae	Typha latifolia L.	TYHLA	0,5	1

22 ESPÉCIES

Echinochloa spp.
PORTUGAL



Complex of species

Barnyarndgrass (*E. crus-galli* spp. *crus-galli*)

Early watergrass (*E. oryzoides*)

Late watergrass (E. phyllopogon = *E.oryzicola*)

Pollacci Barnyardgrass (*E. crus-galli* spp. *hispidula = E. erecta*)

Jungle rice (*E. colona= E. colonum*)

Echinochloa phylopogon–in rice paddy field – Tagus river valley
(Pacheco, 2015)

Other problematic weeds

Parcela infestada com *Leptochloa* spp. – *arrozal do Vale do Tejo*
(Pacheco, 2015)

Weed management

- **Problematic weeds**
  - *Echinochloa* spp. / Herbicide resistant populations
  - *Oryza sativa ssp. sylvatica (weedy rice)*

- **Control measures**
  - Cultural
  - Physical
  - **CHEMICAL (herbicides)**

Herbicides – Different MOA

- azimsulfuron (GULLIVER)
- bensulfuron-methyl (LONDAX 60 DF)
- bensulfuron-methyl + metsulfuron-methyl (PULL 52)
- bentazone (BASAGRAN, KAOS, KAKURU, BENTA 480 SL)
- bispiribac-Na (NOMINEE)
- cyalofop-P-buthyl (CLINCHER, CLINCHER PLUS)
- imazamox (PULSAR 40)
- MCPA (AGROCIDE, HERBITAL, HERBOFITAL 40, HERBINEXA 40K, K 40, MESTRE K, CERIDOR)
- Propaquizafop
- penoxsulam (VIPER)
- penoxsulam + cyalofop-P buthyl (VIPER+)
- penoxsulam + tryclopir (PINDAR)
- profoxidim (AURA)

triclopir
pendimetaline
clomazone
cicloxidim

Herbicides

B

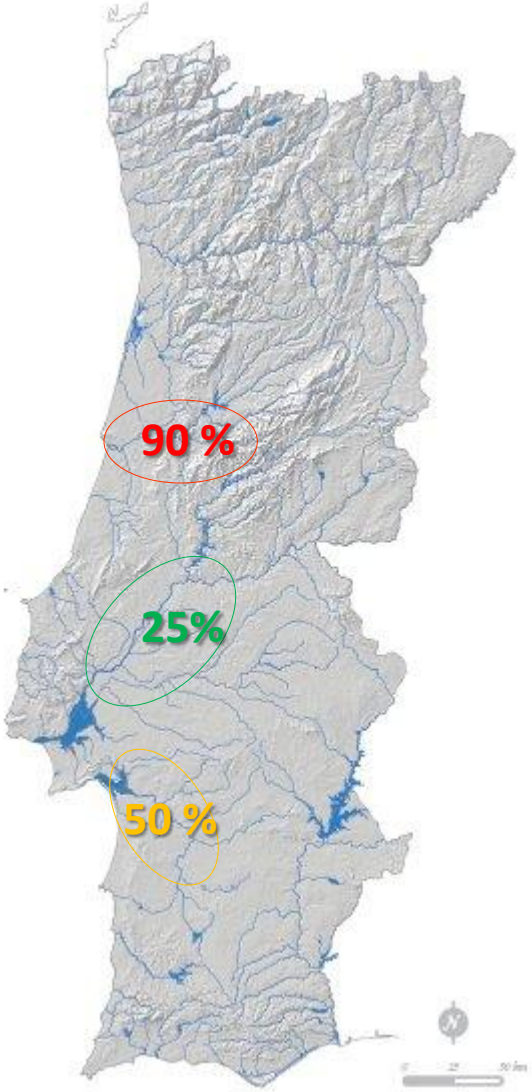
SULF.
azimsulfuron
bensulfuron-methyl
bensulfuron-methyl + metsulfuron
TZP
penoxsulame
PDB
bispiribac - Na
IMI'S
imazamox

A

CHD
cihalofop-P-buthyl

APPA
profoxidim

Resistance to penoxsulam



Beira Litoral (BH Mondego)
6.654 ha

Ribatejo (BH Tagus and Sorraia)
9.565 ha

Alentejo (BH Sado)
10.503 ha

Field survey in Sado RB – Alentejo – south Portugal

Rice cropping systems in south of Portugal, account for 40 % of total area and are located in a transition area from semi-arid to sub humid region (581 mm annual precipitation). Salt and weeds are the main constraints to rice production. *Echinochloa* species are the most problematic weeds in rice, particularly late water-grass (*E. phyllopogon*) populations resistant to ALS-inhibiting herbicides.

Field survey in Sado RB – Alentejo – south Portugal

A herbicide resistance survey to assess resistance risk in this area was carried out with a questionnaire to 30 rice producing farmers

Questions adressed critical agronomic factors such as cropping system (monoculture vs rotation) herbicide history (same or different MOA, mixtures and sequences) weed management practices and water management for the last five years and also farmers perception on herbicide efficacy to particular weeds.

Main weeds - Alentejo

Echinochloa are the most problematic weeds , according to farmers perception .
In ranking of importance they apperar in 1st place (27/30) or in 2nd or 3d place (3/30).

Weedy rice	**Hetherant hera**	Echinochloa spp.	**Alisma plantago aquatica**	**E. phyllopog on**	TOTAL
1	1	**25**	2	1	30

New weeds in 10 % of the cases:
Weedy rice (1/30) and *Leptochloa (2/30)*.




Herbicide resistance - Alentejo

According to farmers perception:

Weed resistance is present in 80 % of rice fields.
Most of the cases refer to resistant populations of Echinochloa only

Weedy rice	Hetheranthera	Leersya	Echinochloa spp.	Cyperus difformis
3 %	3 %	**3 %**	74,23	1

In 20% of fields with resistance, farmers refer to weed resistance of ‘several’ species in the same field ???

Level of satisfaction with herbicides- Alentejo

PRE- Emergence Herbicides
Half of the farmers are not satisfied with herbicides
Only 13,3 % are ‘happy’ or ‘ very happy’ with them.

PRE Emergence Herbicides		Frequency	Percent	Percent cumulative
		4	**13,3**	**13,3**
	Not at all	2	6,7	20,0
	Little satisfaction	9	30,0	50,0
	Midle satisfaction	11	36,7	86,7
	Happy	3	10,0	96,7
	Very happy	1	3,3	100,0
	Total	**30**	**100,0**	

Level of satisfaction with herbicides- Alentejo

For POST - Emergence Herbicides
Farm perception is similar to PRE Herbicdes
.

POST Emergence Herbicides		Frequency	Percent	Percent cumulative
		5	16,7	17,2
	Not at all	9	30,0	48,3
	Little satisfaction	14	46,7	96,6
	Midle satisfaction	1	3,3	100,0
	Happy	29	96,7	
	Very happy	1	3,3	
	Total	**30**	**100,0**	

Herbicide resistance - Alentejo

There is a negative correlation between cover level of Echinochloa and the level of satisfacton to POST herbicides.

However these differences are not significative.

		Ground cover level of Echinochloa (%)						Total
		NA	0-20	20-40	40-60	60-80	80-100	
Level of satisfaction with PRE emergence Herbicides	Not at all	0	1	0	2	1	1	**5**
	Little satisfaction	0	1	4	3	1	0	**9**
	Midle satisfaction	1	6	1	3	3	0	**14**
	Happy	0	0	1	0	0	0	**1**
Total		**1**	**8**	**6**	**8**	**5**	**1**	**29**

		Valor	Erro Padrão Assintótico[a]	T Aproximado[b]	Significância Aproximada
Ordinal por Ordinal	Gama	-,342	,202	-1,615	,106
N de Casos Válidos		29			
a. Não considerando a hipótese nula.					
b. Uso de erro padrão assintótico considerando a hipótese nula.					

Field history – herbicide application Alentejo – south Portugal

Herbicides used from 2013 to 2017 (20 fields)

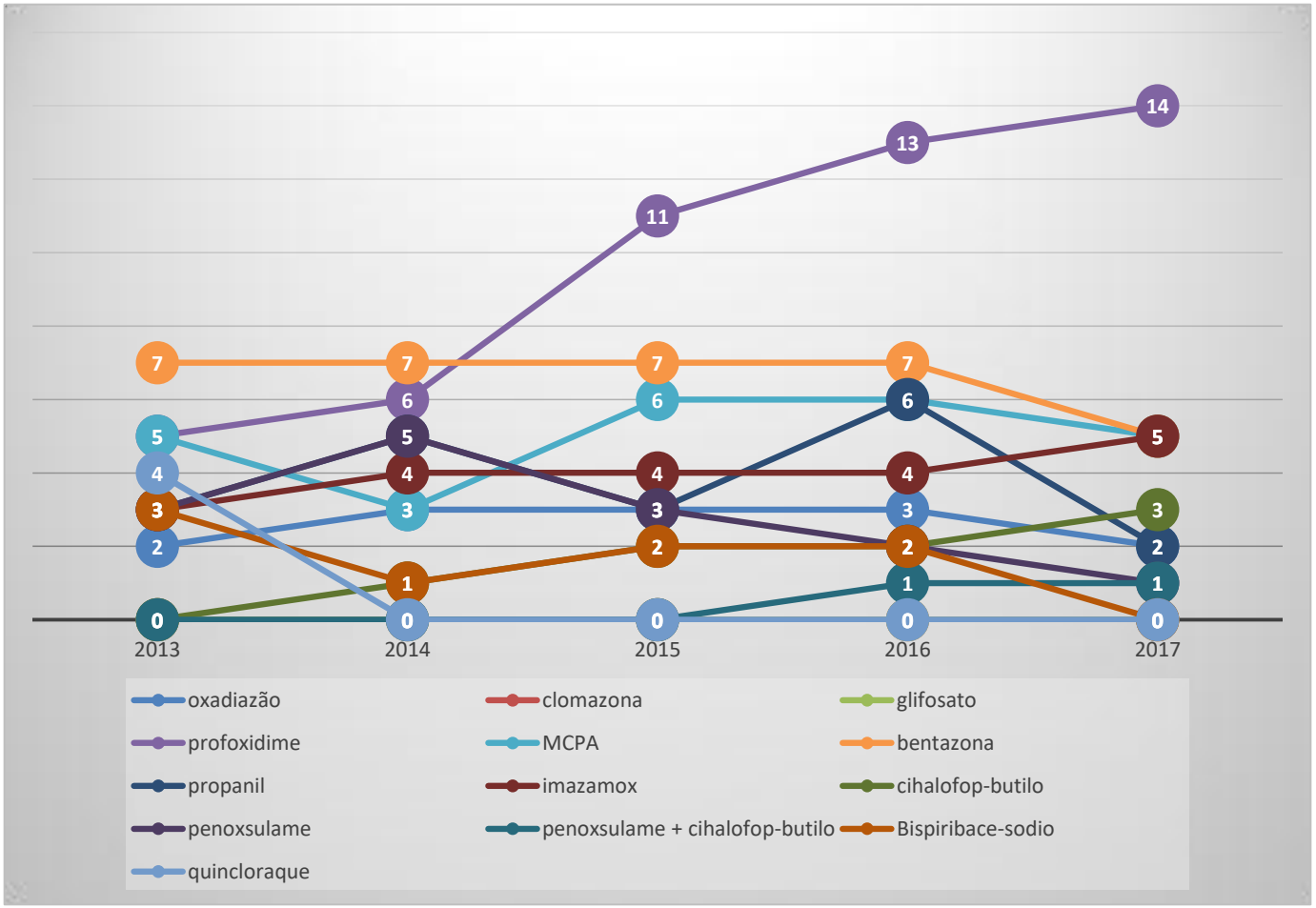
Comparison of year 2018 (30 fields) with the average of the quinquenium 2013 to 2017;

Field history – herbicide use Alentejo – south Portugal

Comparison between year 2018 and average from years 2013 -2017

HERBICIDES	Average 2013-17	2018	variation p.p.
oxadiazon	13,8%	83,3%	69,6%
clomazone	0,0%	13,3%	13,3%
glyphosate	0,0%	3,3%	3,3%
profoxidim	55,0%	83,3%	28,3%
MCPA	25,0%	23,3%	-1,7%
bentazone	32,5%	43,3%	10,8%
propanil	20,0%	10,0%	-10,0%
imazamox	21,3%	46,7%	25,4%

Field history – herbicide use 2013-2017 Alentejo – south Portugal



Crop Rotation

Rice in the last 5 years		Frequency	Percentage	Percentage valide	Percentage cumulativ
	Omisso	1	3,3	3,3	3,3
	No	7	23,3	23,3	26,7
	Yes	22	73,3	73,3	100,0
	Total	30	100,0	100,0	

Only 23,3 % of the fields rotate rice with other crops.

Rice monocropping for the last 5 years was more frequente in most of the fields (73,3%)

Stale seedbed

Stale seedbed (Y/N)					
		Frequency	Percent	Valid Percent	Acumulated Percent
Válido	Omisse	2	6,7	6,7	6,7
	No	26	86,7	86,7	93,3
	Yes	2	6,7	6,7	100,0
	Total	30	100,0	100,0	

Flooded staleseedbed (Y/N)					
		Frequency	Percentage	Percentage válide	Percentage cumulativa
Válide	Omisse	28	93,3	93,3	93,3
	No	1	3,3	3,3	96,7
	Yes	1	3,3	3,3	100,0
	Total	30	100,0	100,0	

Stale seed bed is not a common practice in Alentejo.

It was registed in two fields and only one was floooded .

To control emerged weeds before rice seeding , the farmers use herbicides not mechanical control.

Farmer willing to change

The cross-checking of some variables with the presence of weed resistance indicates that some farmers may respond more quickly to new technologies, modes of production or products.

For example:

- There were six farmers who changed the herbicide application scheme.
- From these, five of them had weed resistance (83%), slightly above the percentage of resistance to the million (77%).
-

- Only three farmers claimed to have changed cultural practice, and in these cases they have also weed resistance in their fields.

Farmer willing to change

		Weed resistance		TOTAL
		No	Yes	
There were changes in herbicide programe ?	**NO**	6	18	**24**
	Clearfield	0	2	**2**
	Clearfield	0	1	**1**
	New a.i clomazone	0	1	**1**
	Ineficacy	1	0	**1**
	Earlier application	0	1	**1**
Total		**7**	**23**	**30**

Farmer willing to change

		Weed resistance		
		No	**Yes**	**Total**
There were changes in cultural practices?	No changes	7	20	**27**
	Annual tillage	0	1	**1**
	Line seeding	0	1	**1**
	Dry seeding	0	1	**1**
Total		**7**	**23**	**30**

+ARROZ – Sustainable rice production in Portugal

- APARROZ Agrupamento De Produtores De Arroz Do Vale Do Sado Lda;
- ANSEME Associação nacional de produtores e comerciantes de sementes;
- GACHA - Sociedade Agricola, Lda;
- INIAV Instituto Nacional de Investigação Agrária e Veterinária IP

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