REZISTENCE PLEVELŮ VŮČI HERBICIDŮM

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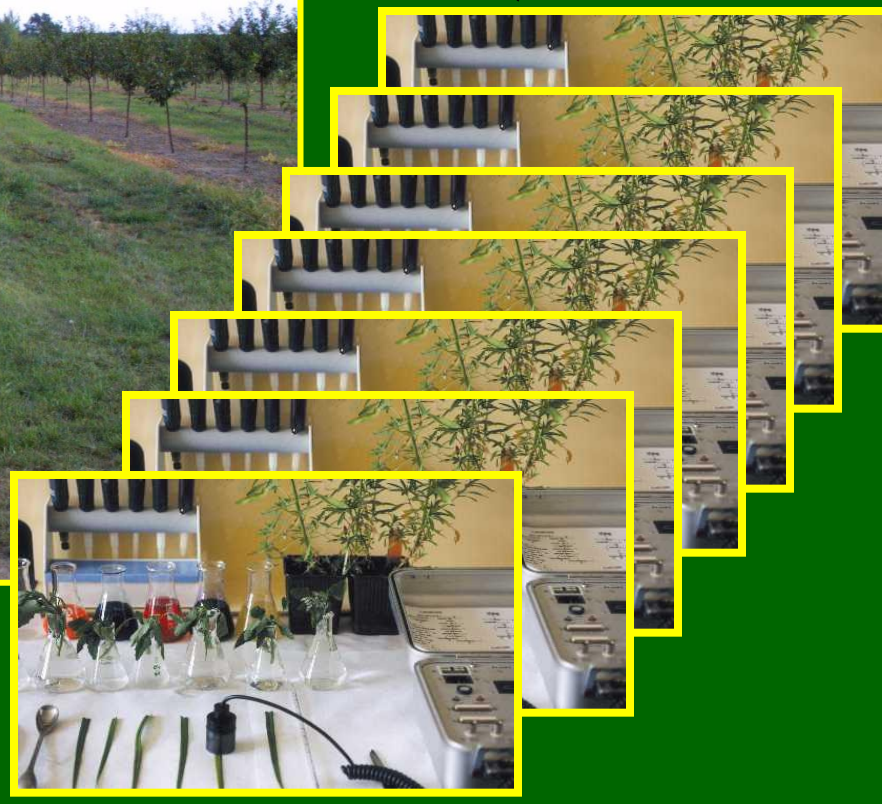
Faktory ovlivňující změny druhového spektra plevelů na zemědělské půdě

- Změna klimatických podmínek - invaze
- Vliv zemědělské činnosti
- Střídání plodin
- Zpracování půdy
- Biologické vlastnosti plevelů - reprodukce
- Vývoj chemické ochrany – rezistence

REZISTENCE -
MINULOST, SOUČASNOST A BUDOUCNOST

?

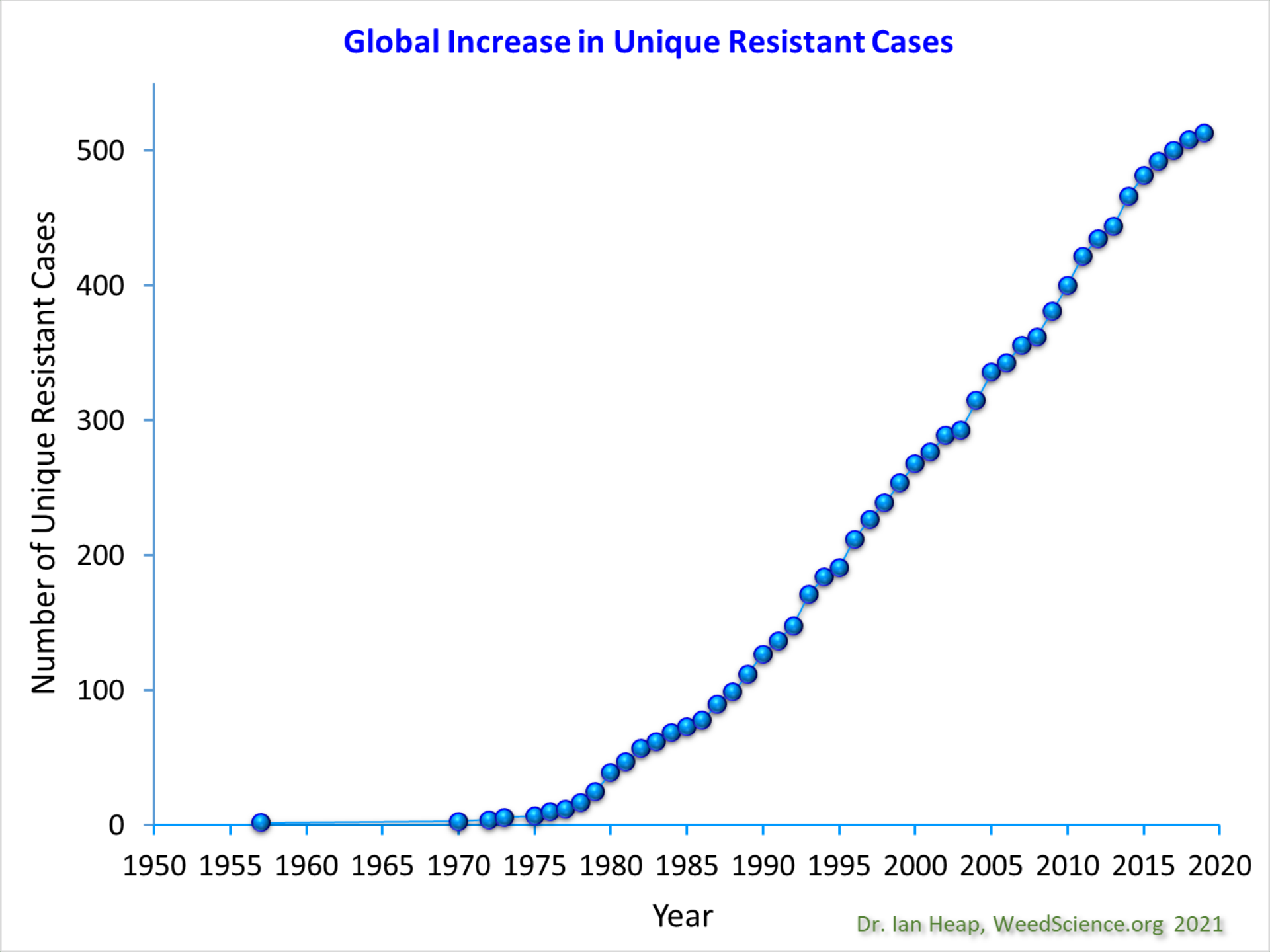


http://www.weedscience.org

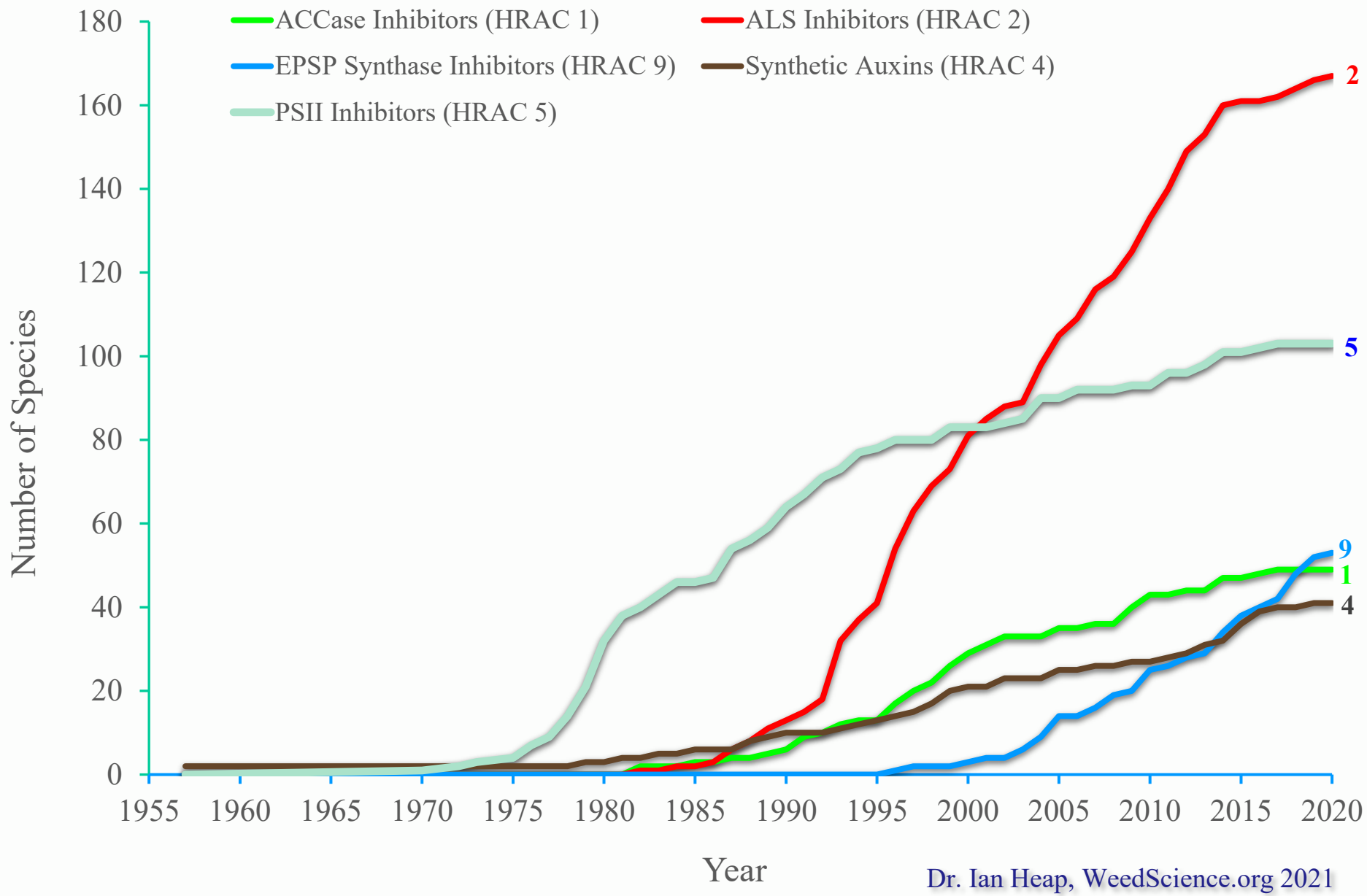
http://www.vurv.cz/weeds/

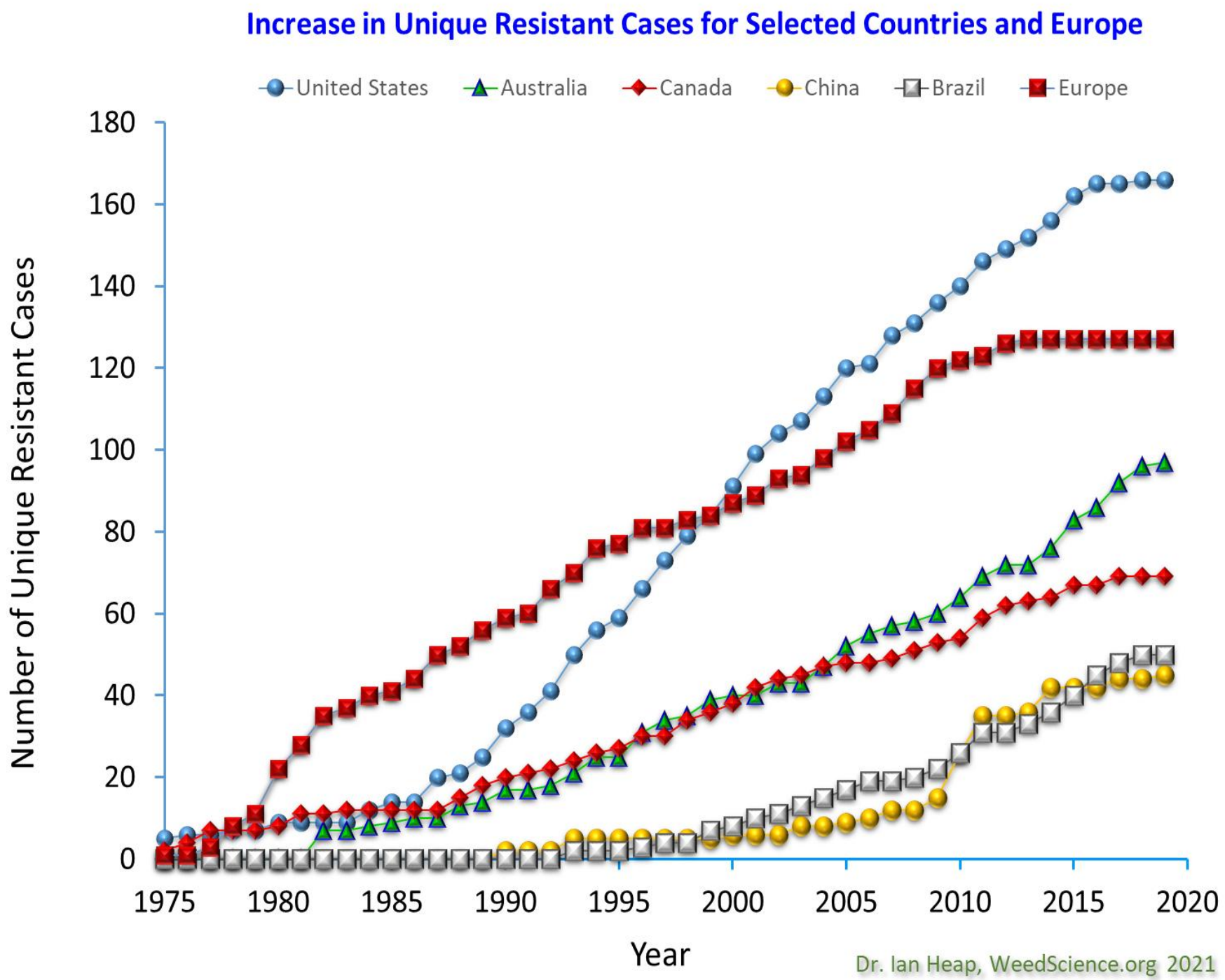
Co je rezistence a tolerance plevelů vůči herbicidům?

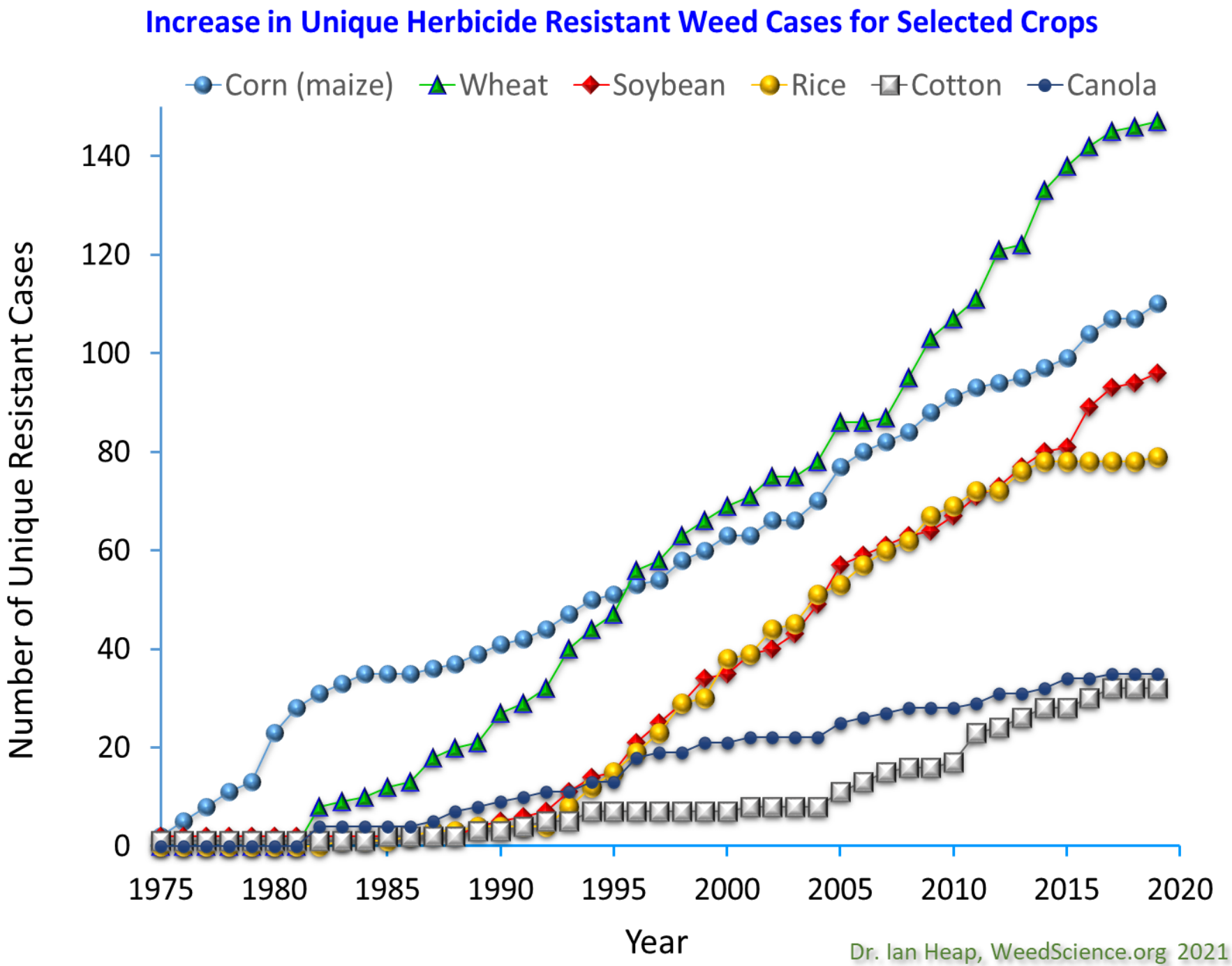
- **Rezistence rostlin:** Rezistence je absolutní tolerance vůči takové dávce herbicidů, která daný druh plevelné rostliny normálně v porostu kulturní rostliny hubí. Jde tedy o to, že plevelný druh byl dříve citlivým vůči používanému herbicidu, ale po jeho delším používání a po opakovaných aplikacích ve vysokých dávkách přežívá a je schopen se reprodukovat. Typickým příkladem v našich podmínkách může být mnohaleté používání atrazinu v kukuřici, kdy se vytvořily rezistentní populace plevelů laskavce ohnutého (*Amaranthus retroflexus*) a merlíku bílého (*Chenopodium album*) v Čechách i na Slovensku.
- **Tolerance rostlin:** je naproti tomu přirozená a normální odolnost vůči používaným herbicidům. Každý plevelný druh je různě odolný vůči spektru používaných herbicidů. Pro příklad lze uvést přirozenou odolnost merlíku bílého (*Chenopodium album*) vůči sulfonylmočovinám nebo heřmánkovce přímořského (*Matricaria maritima*) či chundelky metlice (*Apera spica venti*) vůči MCPA a 2,4-D.


Global Increase in Unique Resistant Cases
Number of Unique Resistant Cases
0
100
200
300
400
500
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020
Year
Dr. Ian Heap, WeedScience.org 2021

Number Resistant Species for Several Herbicide Sites of Action (HRAC Codes)




Increase in Unique Resistant Cases for Selected Countries and Europe
United States
Australia
Canada
China
Brazil
Europe
Number of Unique Resistant Cases
0
20
40
60
80
100
120
140
160
180
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
Dr. Ian Heap, WeedScience.org 2021


Increase in Unique Herbicide Resistant Weed Cases for Selected Crops
Corn (maize)
Wheat
Soybean
Rice
Cotton
Canola
Number of Unique Resistant Cases
0
20
40
60
80
100
120
140
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
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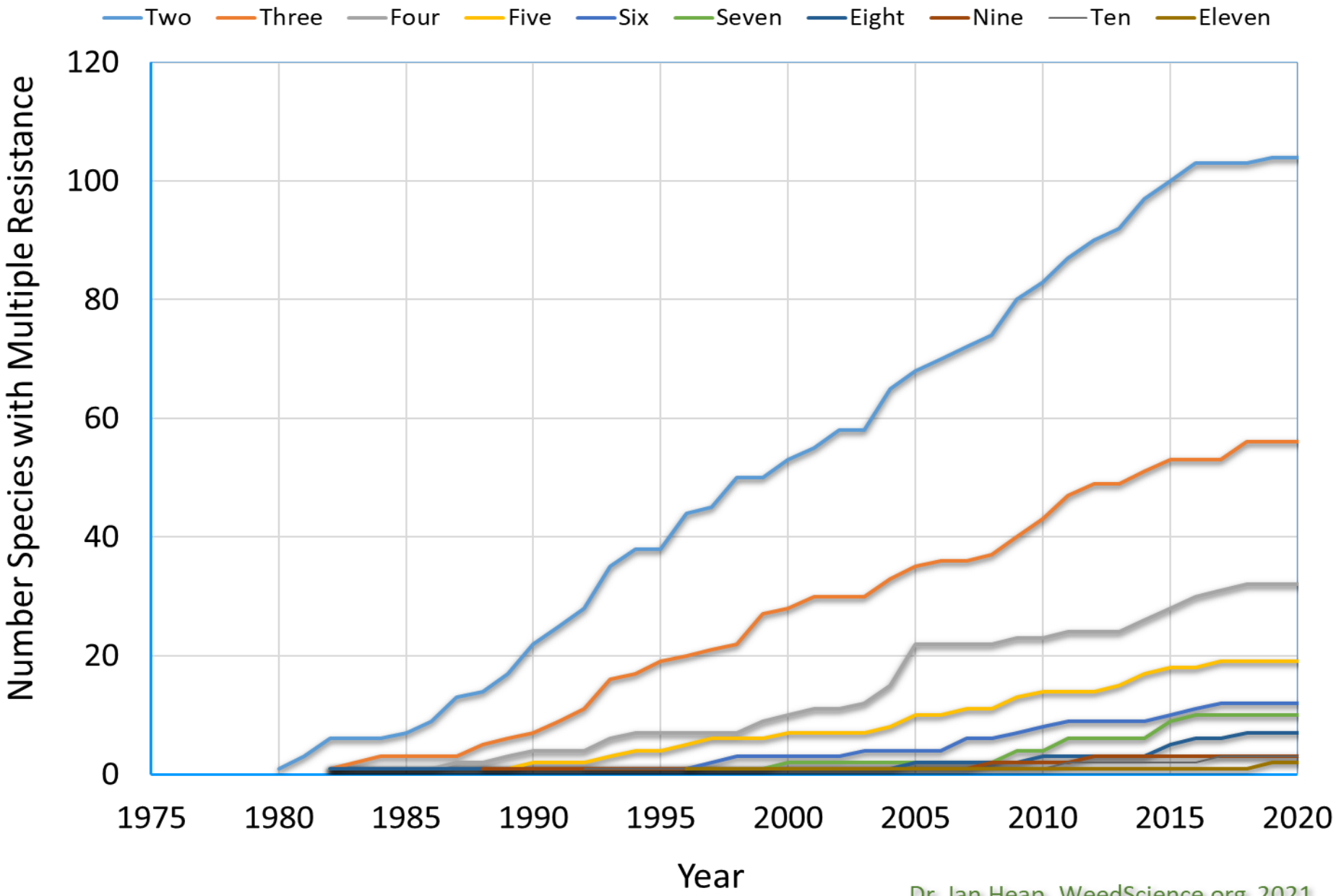
Weed Species with Resistance to More than One Site of Action



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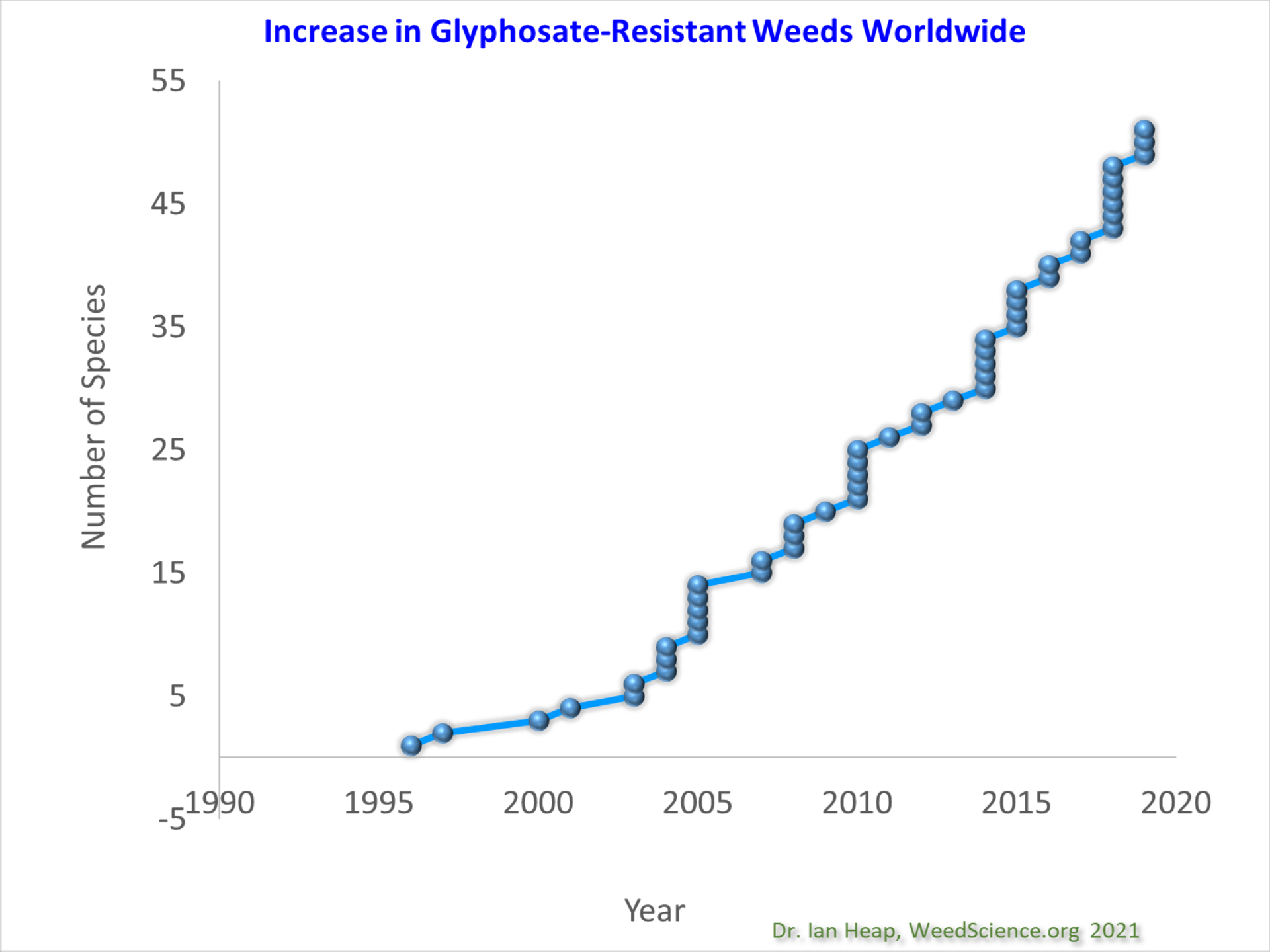
Increase in Glyphosate-Resistant Weeds Worldwide
Number of Species
55
45
35
25
15
5
-5
1990
1995
2000
2005
2010
2015
2020
Year
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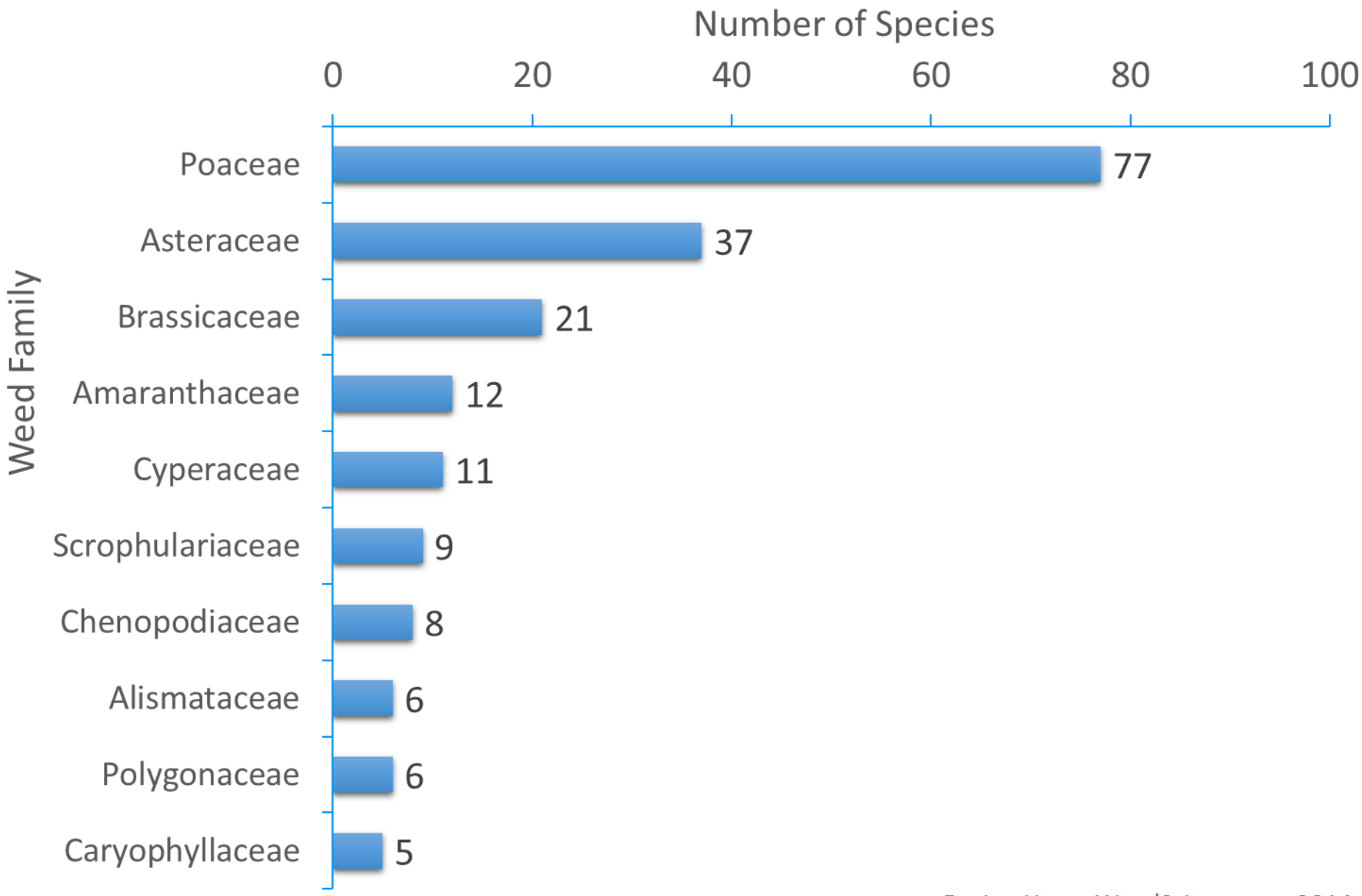
Number of Herbicide Resistant Weed Species by Weed Family (Top 10)



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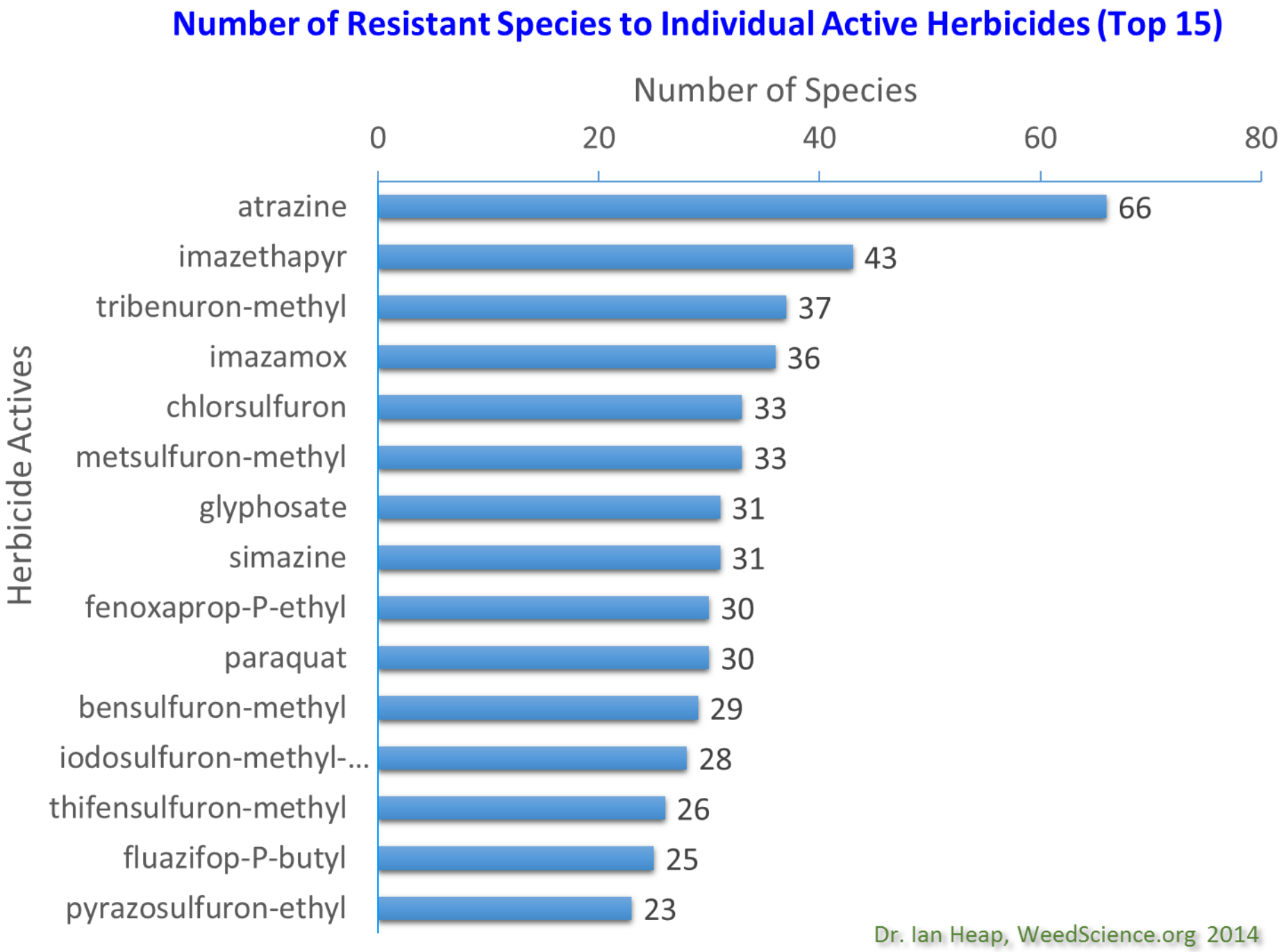
Number of Resistant Species to Individual Active Herbicides (Top 15)
Number of Species
0
20
40
60
80
Herbicide Actives
atrazine
66
imazethapyr
43
tribenuron-methyl
37
imazamox
36
chlorsulfuron
33
metsulfuron-methyl
33
glyphosate
31
simazine
31
fenoxaprop-P-ethyl
30
paraquat
30
bensulfuron-methyl
29
iodosulfuron-methyl-...
28
thifensulfuron-methyl
26
fluazifop-P-butyl
25
pyrazosulfuron-ethyl
23
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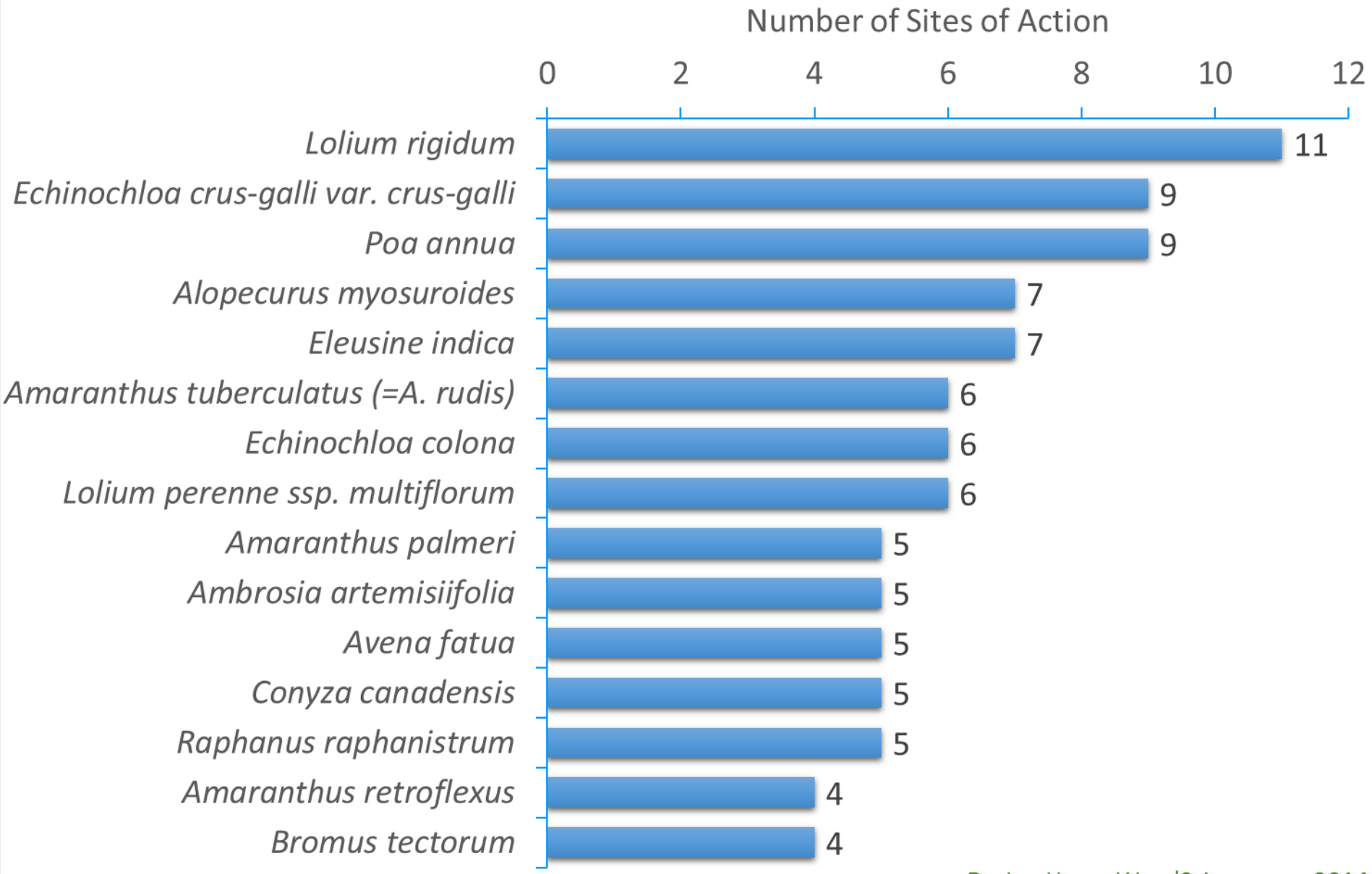
Weed Species Resistance to Multiple Herbicide Sites of Action



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http://www.weedscience.org/

INTERNATIONAL SURVEY OF HERBICIDE RESISTANT WEEDS

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Monday, November 7, 2016

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Glyphosate Resistant Giant Ragweed (*Ambrosia trifida*) infesting Roundup Ready Corn. Photo: Dr. Bill Johnson

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Summaries
- US State Map
- European Map
- Recent Cases
- Countries
- Sites of Action
- All Species by SOA Table
- Herbicides
- Glyphosate Resistant Weeds
- ALS Mutation Database
- Sequence Database
- Graphs
- Global Maps
- Herbicide Poster
- Herbicide Classification System

Resistant Weeds
- By Site of Action
- By Crop
- By Species

PowerPoint Charts Available for Download - Spring 2016

High resolution PowerPoint charts available for presentations and extension publications. The PowerPoint contains charts made in Excel. Data from Spring, 2016. WSSA version (WSSA Group Numbers) and HRAC version (HRAC Group Letters).

Guidelines for Minimizing the Risk of Glyphosate Resistance in the UK.

WRAG (UK Weed Resistance Action Group) has done a great job developing these guidelines, you can download them here: Guidelines for Minimizing the Risk of Glyphosate Resistance in the UK.

International Survey of Herbicide Resistant Weeds

Monday, November 7, 2016

There are currently **473 unique cases** (species x site of action) of herbicide resistant weeds globally, with **251 species** (146 dicots and 105 monocots). Weeds have evolved resistance to **23 of the 26 known herbicide sites of action and to 160 different herbicides**. Herbicide resistant weeds have been reported in **88 crops in 66 countries**. The website has 2356 registered users and 506 weed scientists have contributed new cases of herbicide resistant weeds. View Recent Additions, Site of Action Summary, or the Herbicide Classification System.

SELECT LISTS OF HERBICIDE-RESISTANT WEEDS BY ONE OF THE BELOW

Weed Species	Go	Weed Common Name	Go
Herbicide Site of Action	Go	Crop	Go
US State	Go	Country	Go

Tip - type in boxes (autocomplete like google)

About This Survey

The purpose of this survey is to monitor the evolution of herbicide-resistant weeds and assess their impact throughout the world. The site is a global collaboration between weed scientists with a common goal of understanding, preventing and managing the occurrence of herbicide-resistant weeds.

INTERNATIONAL SURVEY OF HERBICIDE RESISTANT WEEDS

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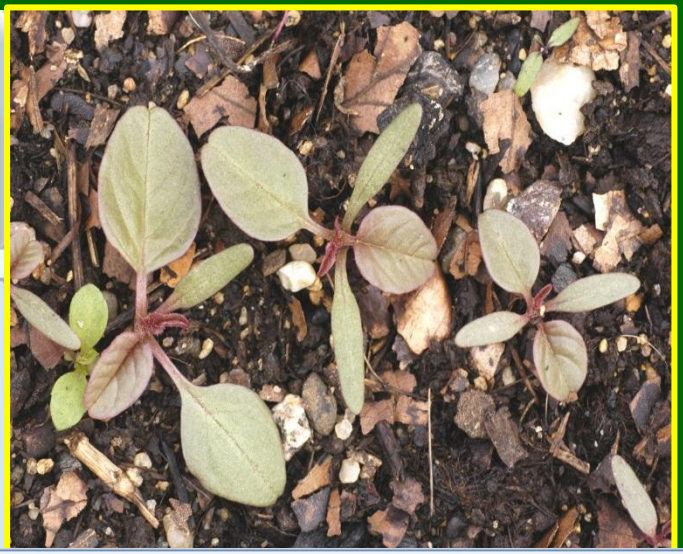
US State Map
European Map
Recent Cases
Countries
Sites of Action
All Species by SOA Table
Herbicides

Herbicide Resistant Weeds by Country and Site of Action

(click on a column header to sort or click on a country for details)

#	Country	Total	A	B	C1	C2	D	G	K1	O	Other
1	Argentina	16	3	4	0	0	0	9	0	0	0
2	Australia	83	12	25	7	0	10	13	2	3	11
3	Austria	5	0	2	2	1	0	0	0	0	0
4	Belgium	22	2	4	8	1	3	0	1	0	3
5	Bolivia	8	4	2	0	0	0	1	0	0	1
6	Brazil	42	6								
7	Bulgaria	4	0								
8	Canada	64	4								
9	Chile	16	5								
10	China	41	8								
11	Colombia	6	1								



Drag a column header and drop it here to group by that column

Herbicide Resistant Weeds in Czech Republic

#	Species	Common Name	First Year	Site of Action
1	*Polygonum lapathifolium*	Pale Smartweed	**1982**	Photosystem II inhibitors (C1/5)
2	*Amaranthus retroflexus*	Redroot Pigweed	**1985**	Photosystem II inhibitors (C1/5)
3	*Chenopodium album*	Common Lambsquarters	**1986**	Photosystem II inhibitors (C1/5)
4	*Conyza canadensis*	Horseweed	**1987**	Photosystem II inhibitors (C1/5)
5	*Senecio vulgaris*	Common Groundsel	**1988**	Photosystem II inhibitors (C1/5)
6	*Poa annua*	Annual Bluegrass	**1988**	Photosystem II inhibitors (C1/5)
7	*Amaranthus powellii*	Powell Amaranth	**1989**	Photosystem II inhibitors (C1/5)
8	*Chenopodium album var. striatum (=C. strictum var. glaucophyllum)*	Lateflowering Goosefoot	**1989**	Photosystem II inhibitors (C1/5)
9	*Polygonum persicaria*	Ladysthumb	**1989**	Photosystem II inhibitors (C1/5)
10	*Echinochloa crus-galli var. crus-galli*	Barnyardgrass	**1994**	Photosystem II inhibitors (C1/5)
11	*Kochia scoparia*	Kochia	**1996**	**Multiple Resistance: 2 Sites of Action** ALS inhibitors (B/2) Photosystem II inhibitors (C1/5)
12	*Solanum nigrum*	Black Nightshade	**1999**	Photosystem II inhibitors (C1/5)
13	*Digitaria sanguinalis*	Large Crabgrass	**2005**	Photosystem II inhibitors (C1/5)
14	*Apera spica-venti*	Silky Windgrass	**2005**	**Multiple Resistance: 2 Sites of Action** ALS inhibitors (B/2)

GROUP C1/5 RESISTANT COMMON LAMBSQUARTERS
(*Chenopodium album*)

Photosystem II inhibitors (C1/5)

Czech Republic

Case Details | Similar Cases Globally | Specific Papers about this Case | Papers for Similar Cases

INTRODUCTION

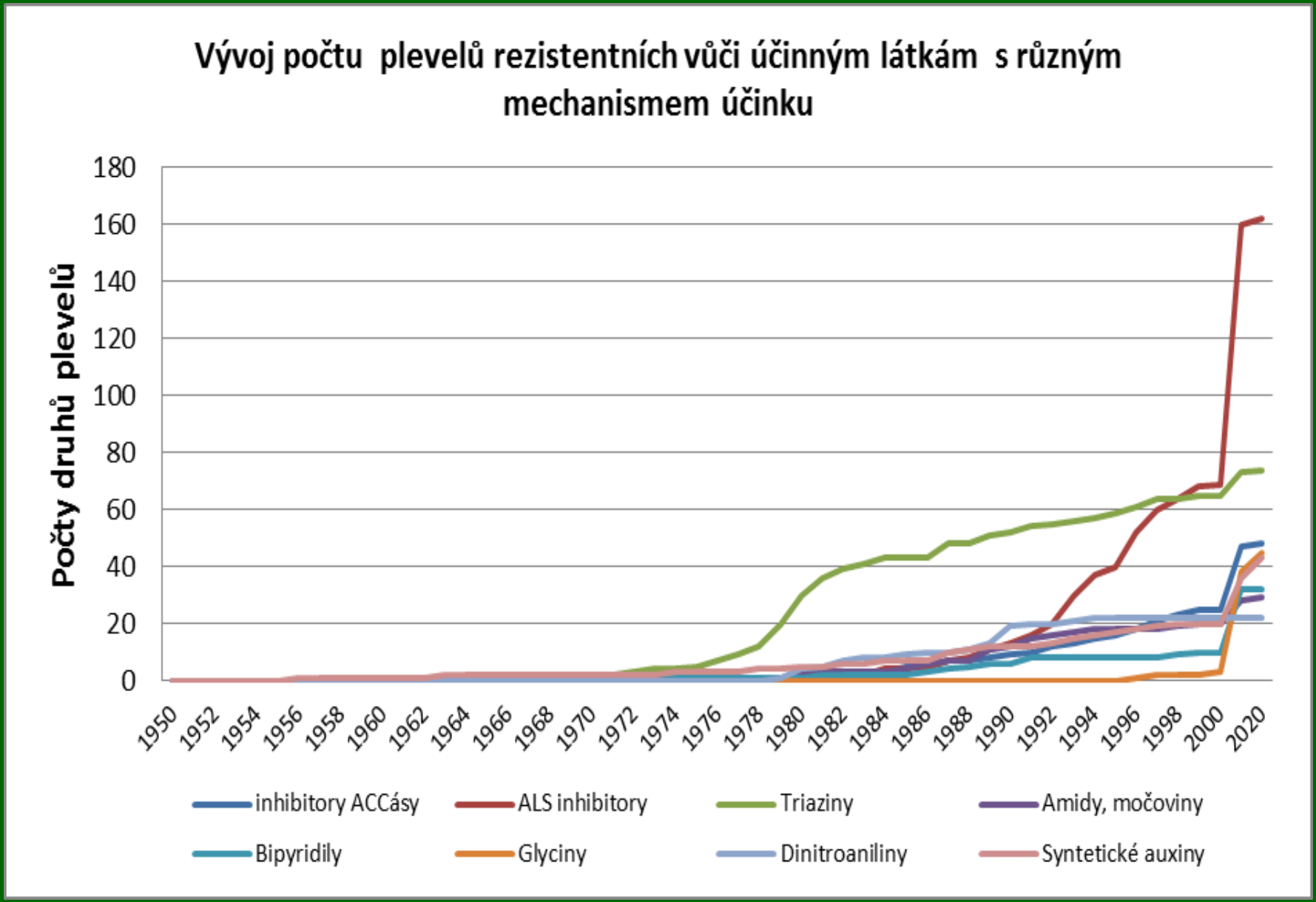
Common Lambsquarters (*Chenopodium album*) is a dicot weed in the Chenopodiaceae family. In Czech Republic this weed first evolved resistance to Group C1/5 herbicides in 1986 and infests Corn (maize), and Sugar beets. Group C1/5 herbicides are known as Photosystem II inhibitors (Inhibition of photosynthesis at photosystem II). Research has shown that these particular biotypes are resistant to atrazine, cyanazine, lenacil, prometon, simazine, terbuthylazine, and terbutryn and they may be cross-resistant to other Group C1/5 herbicides.

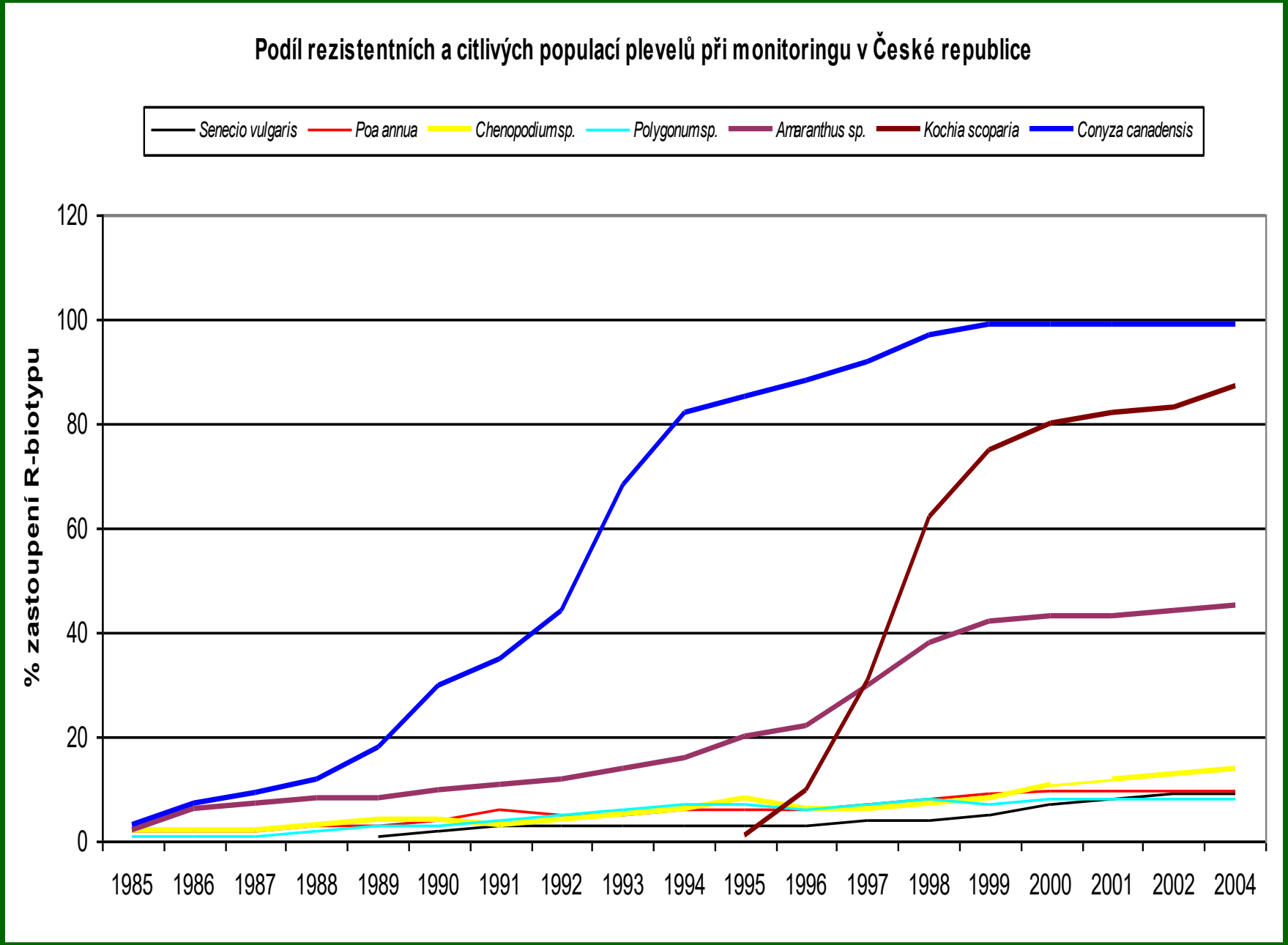
The 'Group' letters/numbers that you see throughout this web site refer to the classification of herbicides by their site of action. To see a full list of herbicides and HRAC herbicide classifications click here.

COMMON LAMBSQUARTERS

QUIK STATS (last updated Nov 18, 2000)

Common Name	**Common Lambsquarters**
Species	*Chenopodium album*
Group	Photosystem II inhibitors (**C1/5**)
Herbicides	atrazine, cyanazine, lenacil, prometon, simazine, terbuthylazine, and terbutryn
Location	Czech Republic
Year	1986
Situation(s)	Corn (maize), and Sugar beets
Contributors - (Alphabetically)	Jan Mikulka


Vývoj počtu plevelů rezistentních vůči účinným látkám s různým mechanismem účinku
Počty druhů plevelů
180
160
140
120
100
80
60
40
20
0
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2020
inhibitory ACCásy
ALS inhibitory
Triaziny
Amidy, močoviny
Bipyridily
Glyciny
Dinitroaniliny
Syntetické auxiny


Podíl rezistentních a citlivých populací plevelů při monitoringu v České republice
Senecio vulgaris
Poa annua
Chenopodium sp.
Polygonum sp.
Amaranthus sp.
Kochia scoparia
Conyza canadensis
% zastoupení R-biotypu
120
100
80
60
40
20
0
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2004

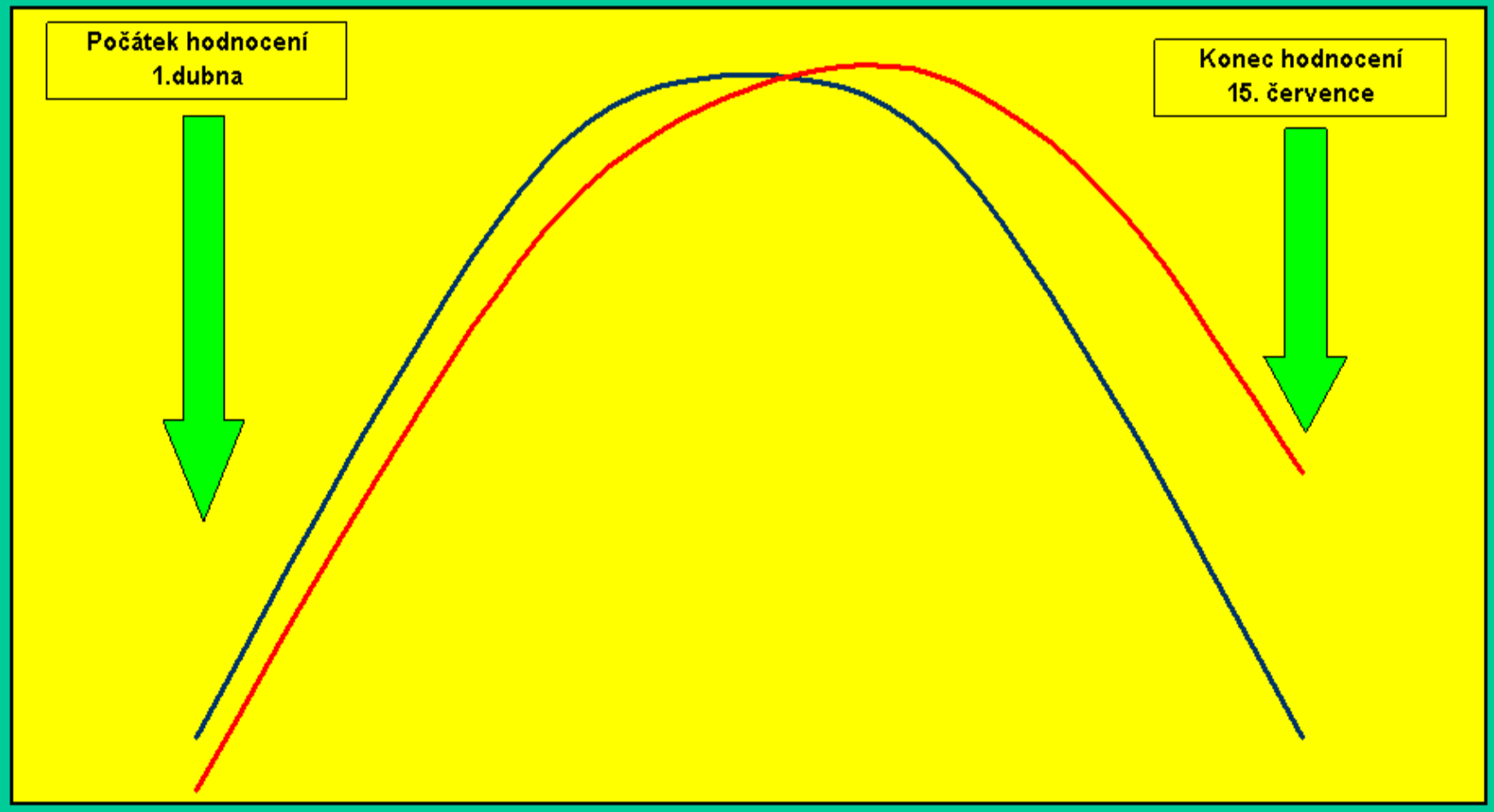
Weed Species	Year of det.	Cross-Resistance
Amaranthus retroflexus	1985	atrazine, simazine, prometryn, terbutryn, cyanazine
Amaranthus powellii	1989	atrazine, simazine, prometryn, terbutryn, cyanazine
Chenopodium album	1986	atrazine, simazine, prometryn, terbutryn, terbuthylazine, cyanazine, chloridazon, lenacil
Chenopodium strictum	1989	atrazine, simazine, prometryn, terbutryn, terbuthylazine, cyanazine, chloridazon, lenacil
Polygonum lapathifolium	1987	atrazine, simazine, prometryn, terbutryn, terbuthylazine, cyanazine, chloridazon, lenacil
Polygonum persicaria	1989	atrazine, simazine, prometryn, terbutryn, terbuthylazine, cyanazine, chloridazon, lenacil
Conyza canadensis	1987	atrazine, simazine, prometryn, cyanazine, paraquat, diquat
Senecio vulgaris	1988	atrazine, simazine, prometryn, terbutryn, terbuthylazine, cyanazin, chloridazon, lenacil
Poa annua	1988	atrazine, simazine, prometryn, terbutryn, cyanazine
Echinochloa cruss-galli	1994	atrazine, simazine,
Setaria viridis	1994	atrazine, simazine,
Chenopodium pedunculare	1999	atrazine, simazine,
Kochia scoparia	1998	atrazine, chlorsulfuron, imazapyr
Solanum nigrum	1999	atrazine

Chundelka metlice – ALS

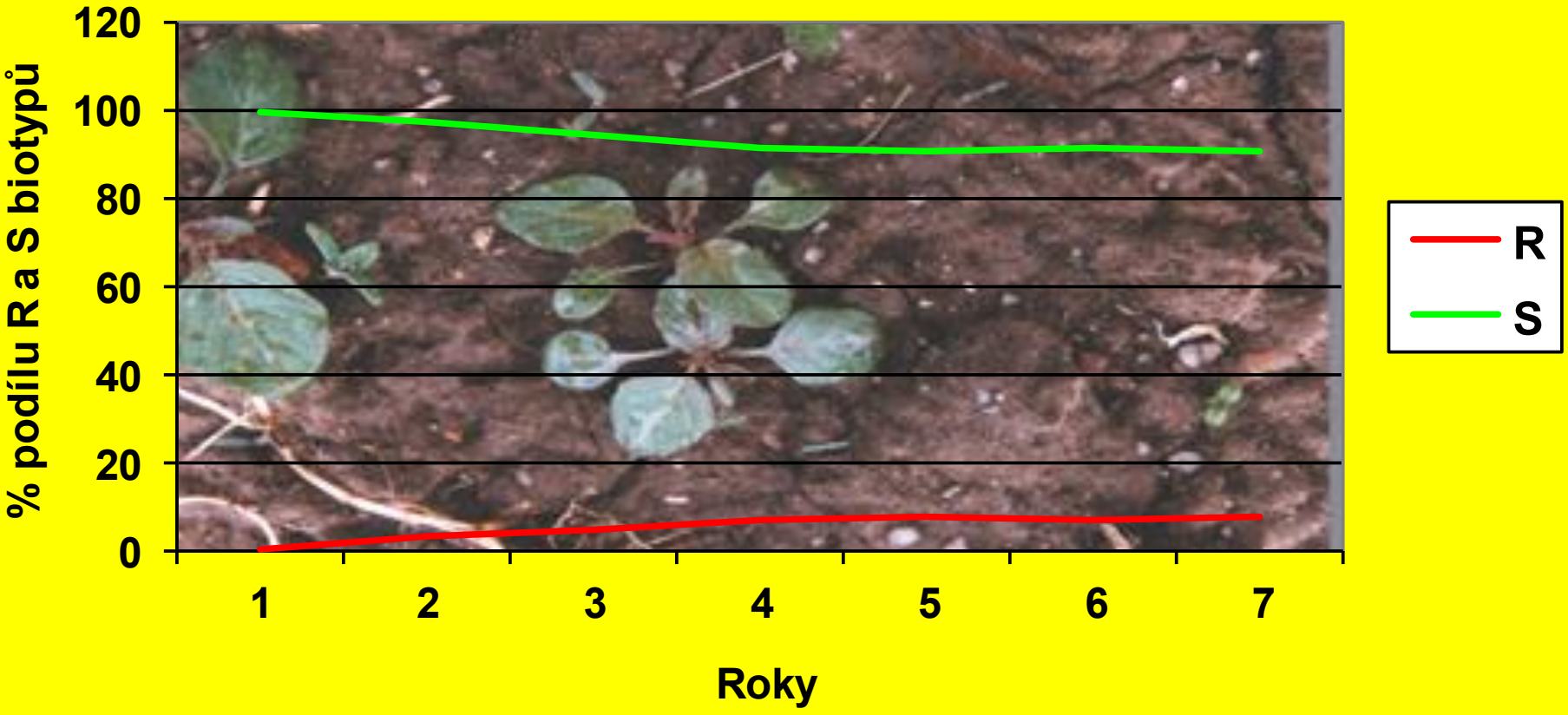
Psárka polní - ALS

Turan kanadský - Glyphosate

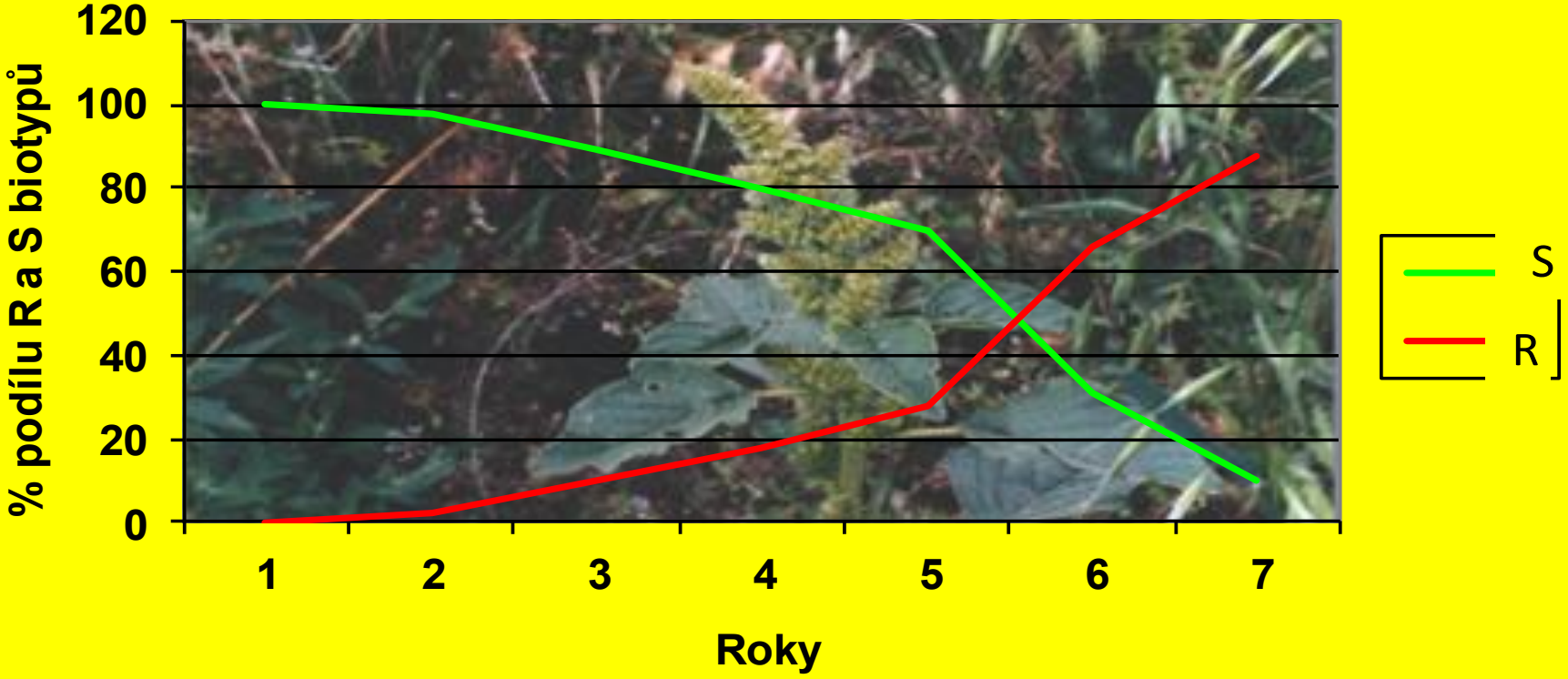
Vzcházení rozdílných populací laskavce ohnutého



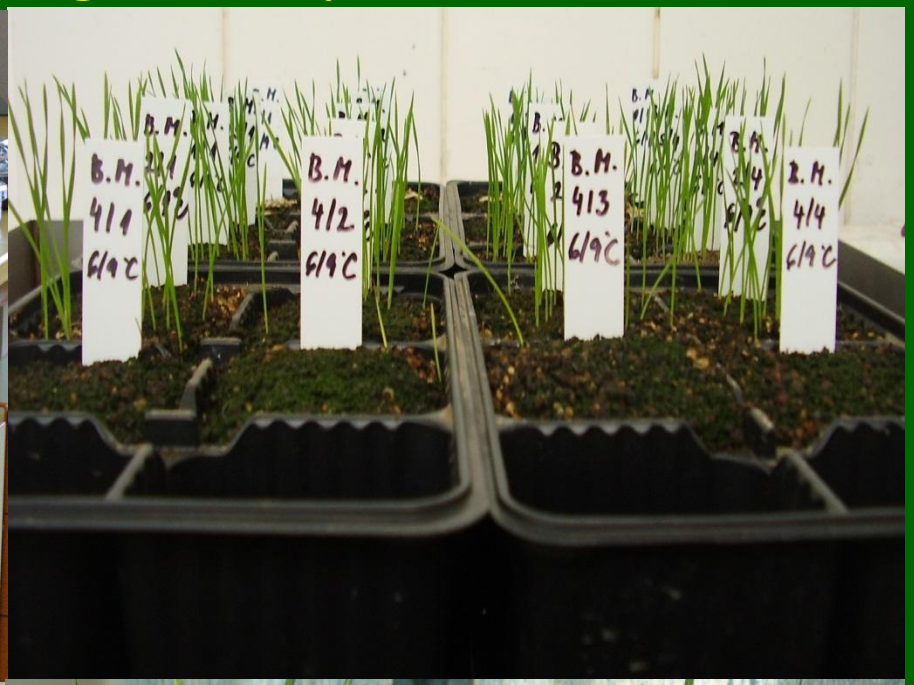
Vliv střídání herbicidů s rozdílným mechanismem účinku na výskyt R a S plevelů v kukuřici

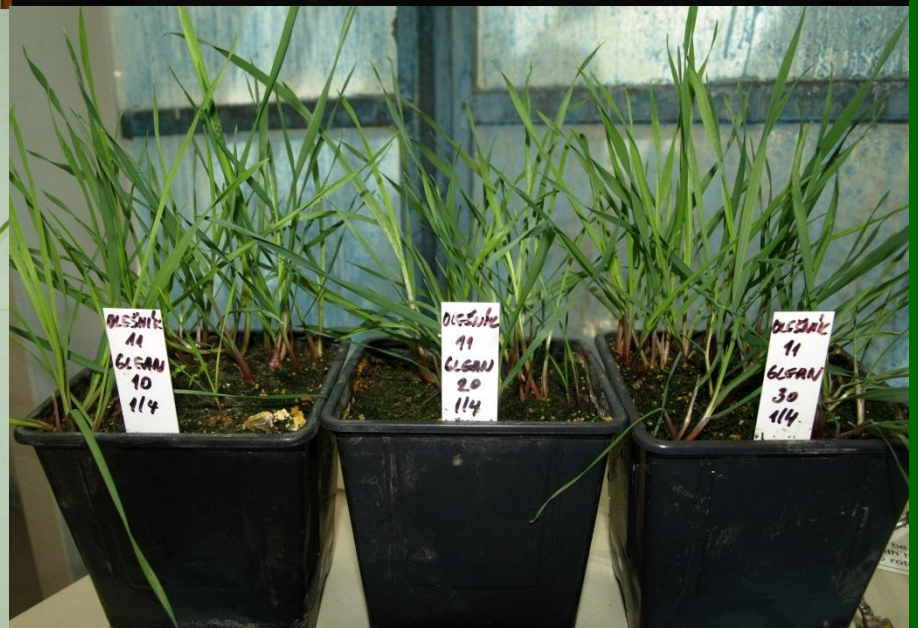


Vliv víceleté herbicidů na podíl R a S rostlin plevelů



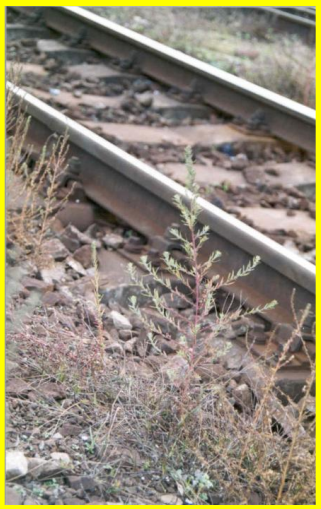
Psárka polní – biologické testy





OLEŠNÍK
9
GLEAN
10
1/4
OLEŠNÍK
9
GLEAN
20
1/4
OLEŠNÍK
9
GLEAN
30
1/4
OLEŠNÍK
9
Kn

Bytel metlatý *(Kochia scoparia)*

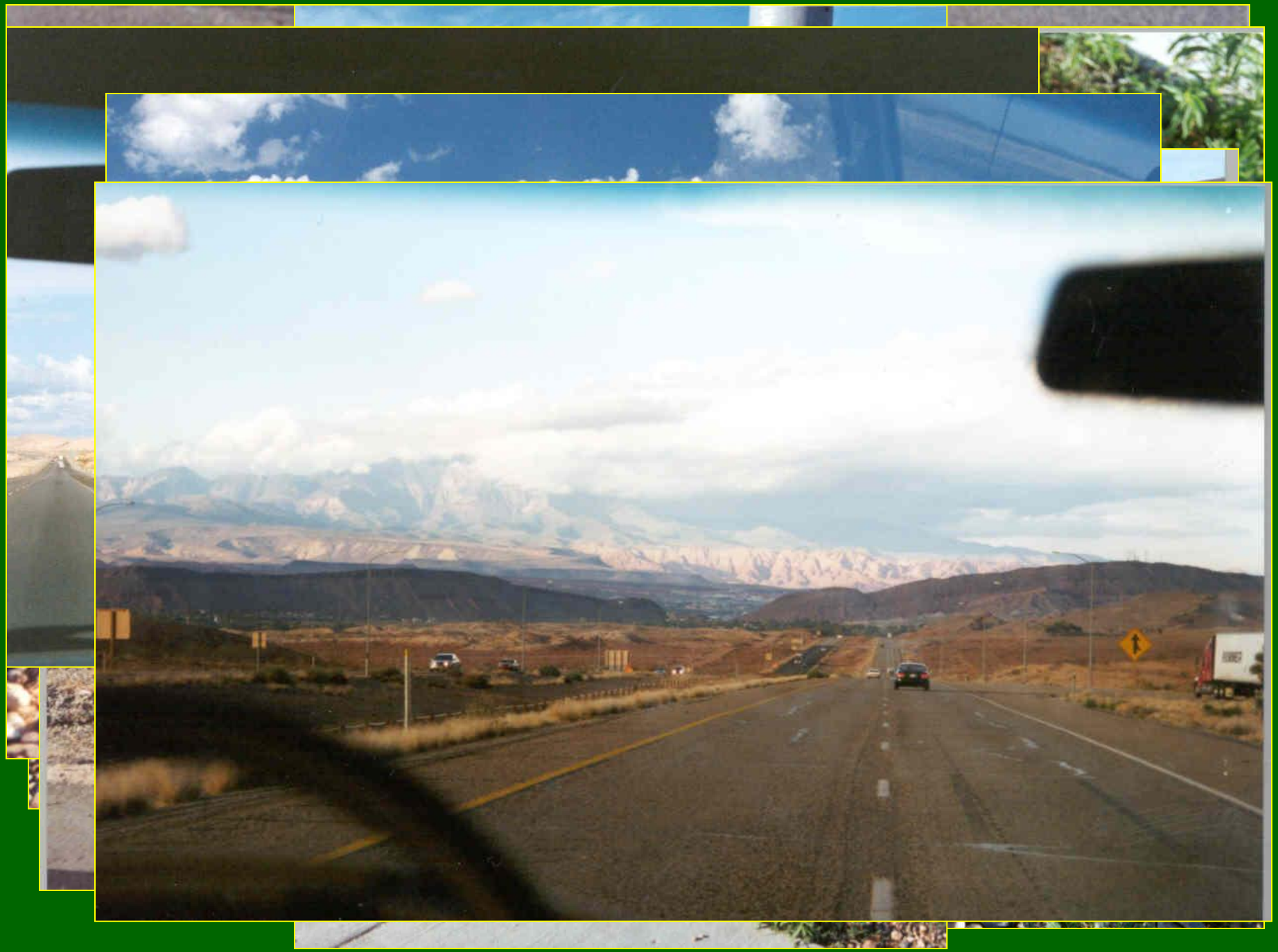


OOCL

ZÓNA
20

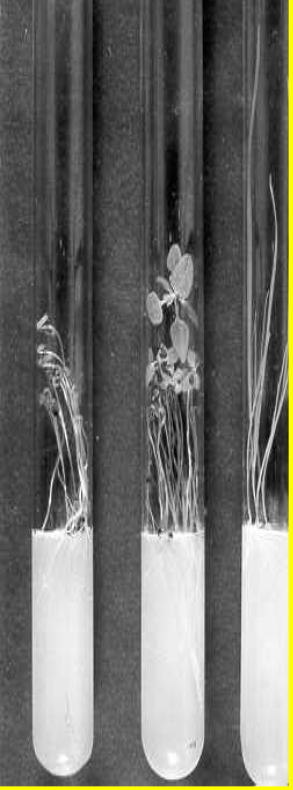
CENTRE
ACCOMMODATION

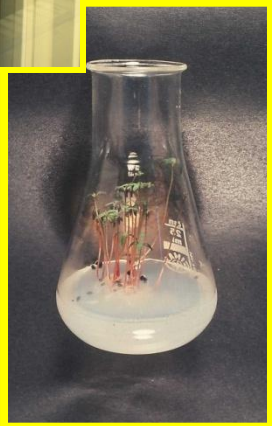
Nýrany s.r.o.
377 932 287
606 940 042

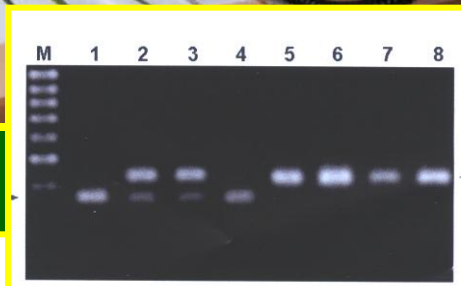


Bytel metlatý *(Kochia scoparia)*

Metody diagnostiky







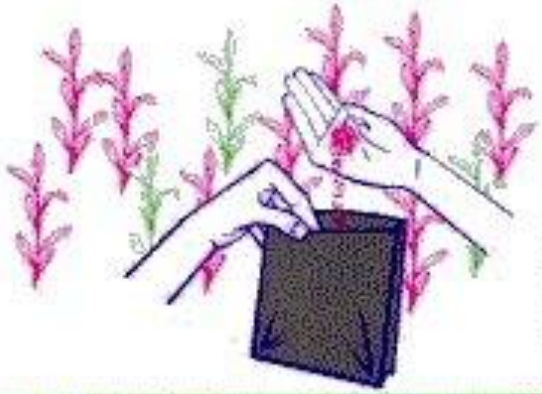
Electrophoreogram (RFLP-PCR, MfeI, gene ALS, Kochia)

Monitoring na železnici

JARO
JARO

Monitoring na železnici

1 Collect seeds from surviving plants



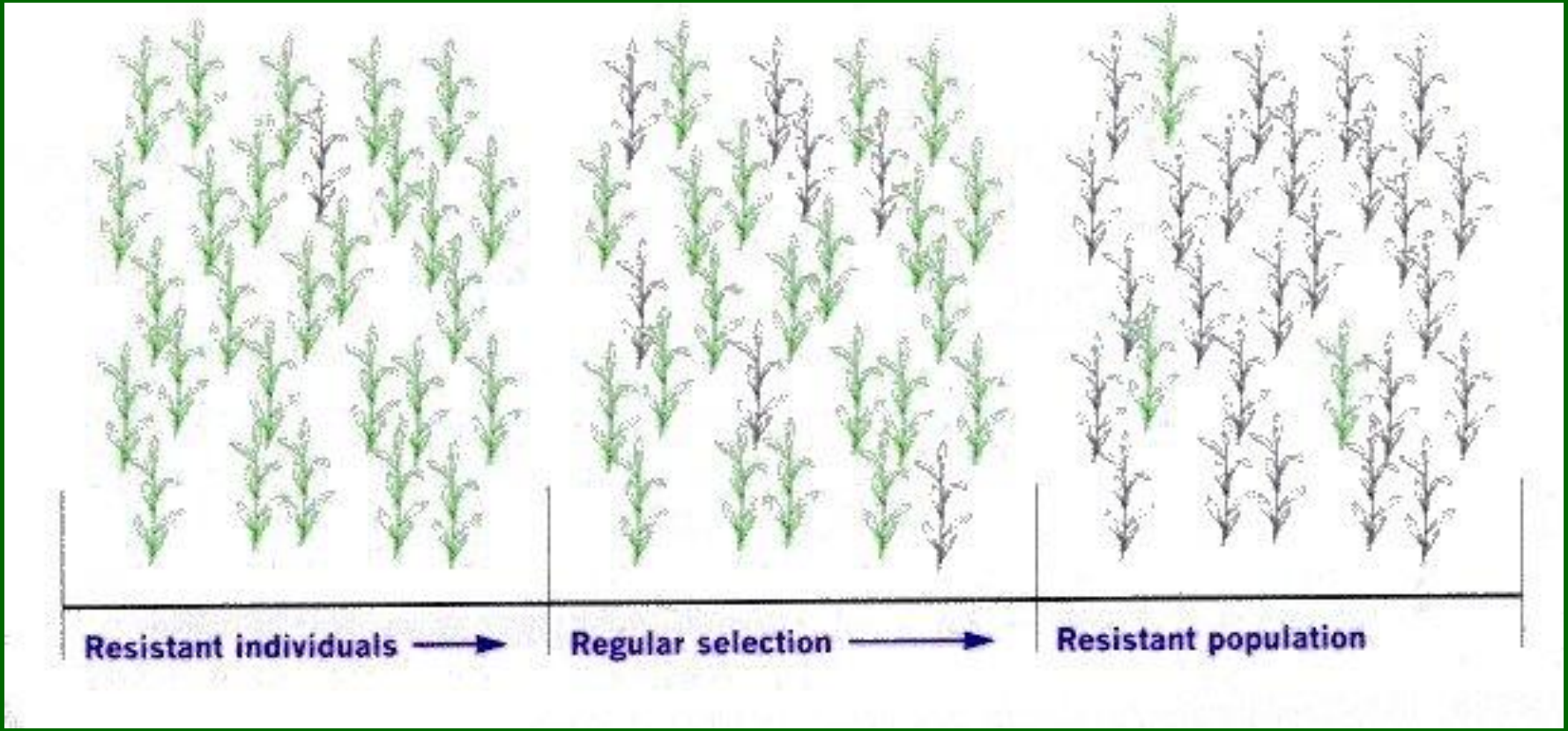
2 Put approximately 1000 seeds in a paper bag

3 Record information

4 Also collect 'normal' seeds from adjacent non-treated area

5 Mark samples with a reference number

6 Send to laboratory for glasshouse testing


Resistant individuals
Regular selection
Resistant population

Aktuální rizika rezistence

- **Riziko rezistence vůči inhibitorům ALS** *Alopecurus myosuroides, Ambrosia artemisiifolia, Apera spica venti a Kochia scoparia).*
- **Riziko rezistence vůči inhibitorům ACCázy** *(Alopecurus myosuroides, Setaria viridis a Echinochloa cruss-galli).*
- **Riziko rezistence vůči glyphosatu** (*Lolium rigidum Lolium multiflorum, Conyza canadensis, Plantago lanceolata).*