



# 국내 화학 작물보호제 개발현황

## Development Status of New Agrochemicals in Korea

2007. 10. 26

고객지원실장 정 봉진상무

## WAR against Diseases/Insects/Weeds !



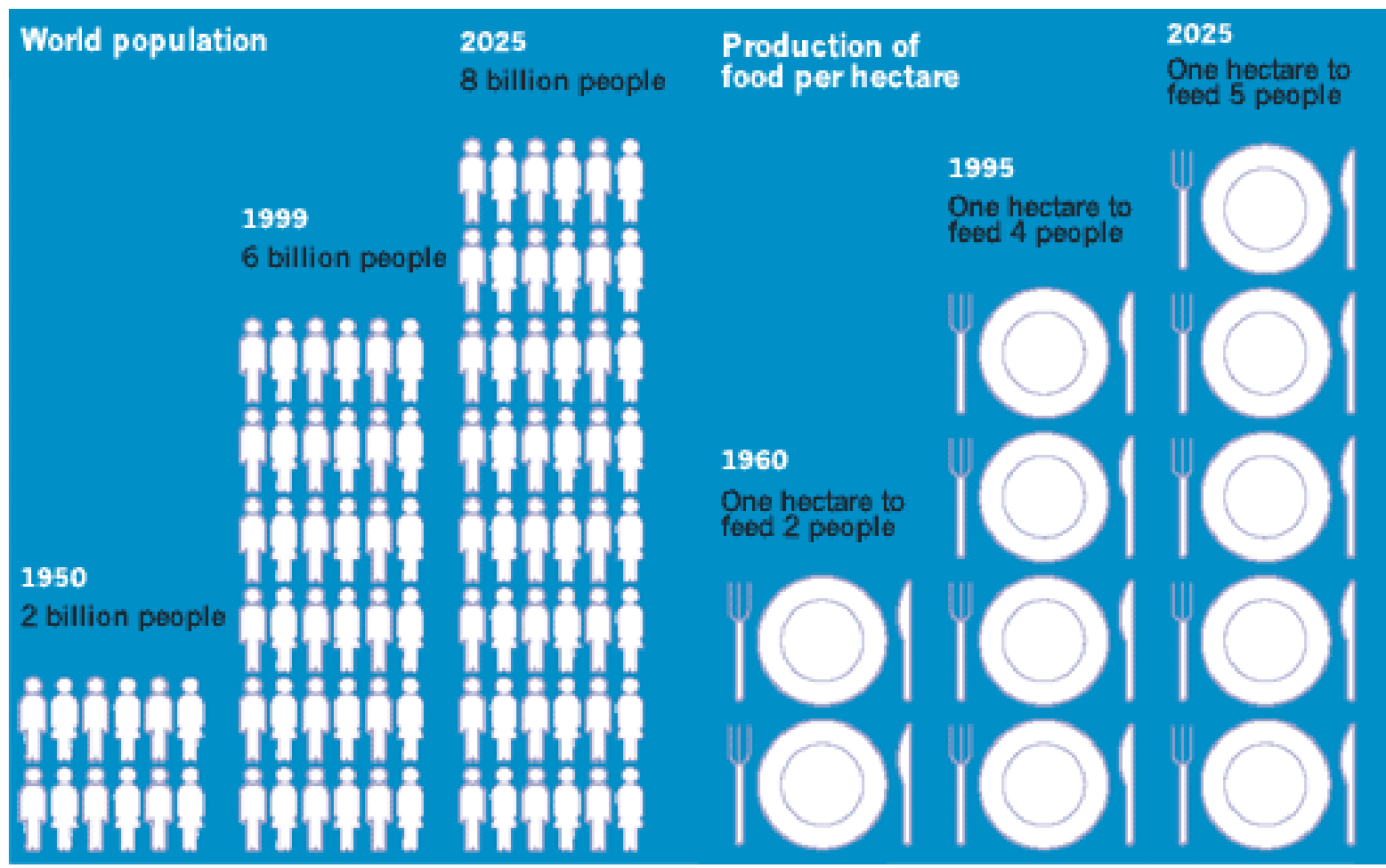
What is best???

- Fast and long residual effect...
- **Safe** to Environment...
- Low application dose...
- **Ease** to Use...

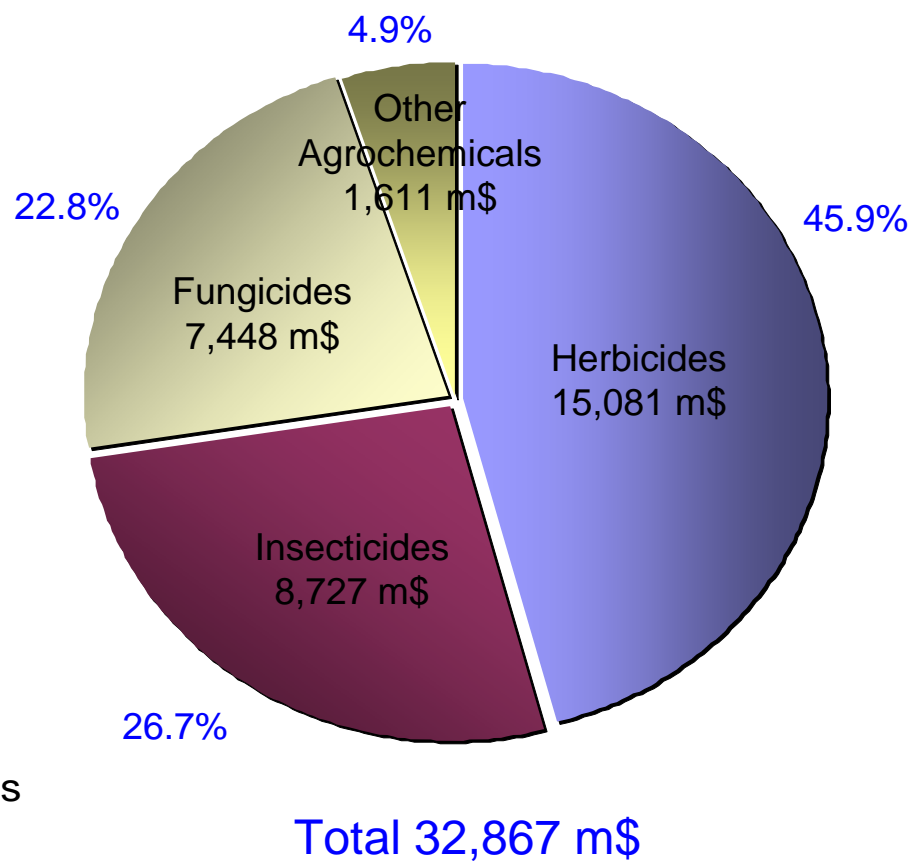
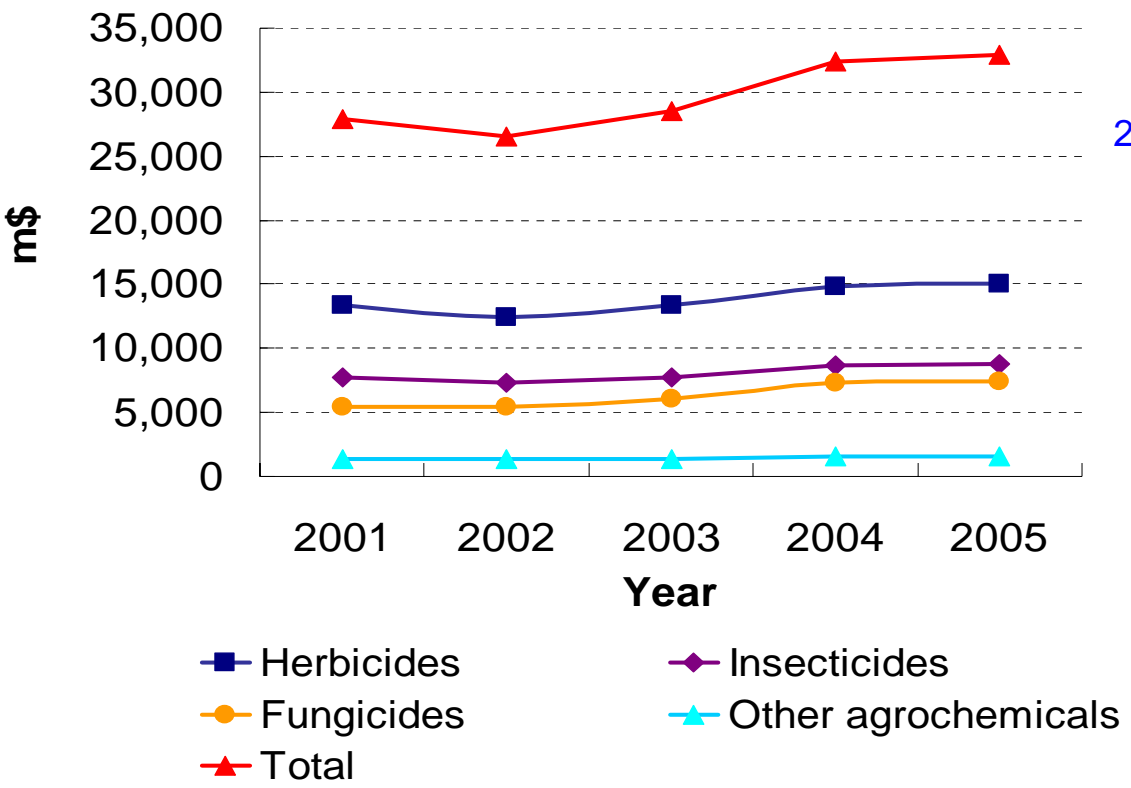
- 
- **New Molecules**
  - **New Formulation/Application**

# Why needs crop protection ?

□ Crop Protection ∞ Food Production ∞ Sustainable Industry



## Crop Protection Sales Trend in the World

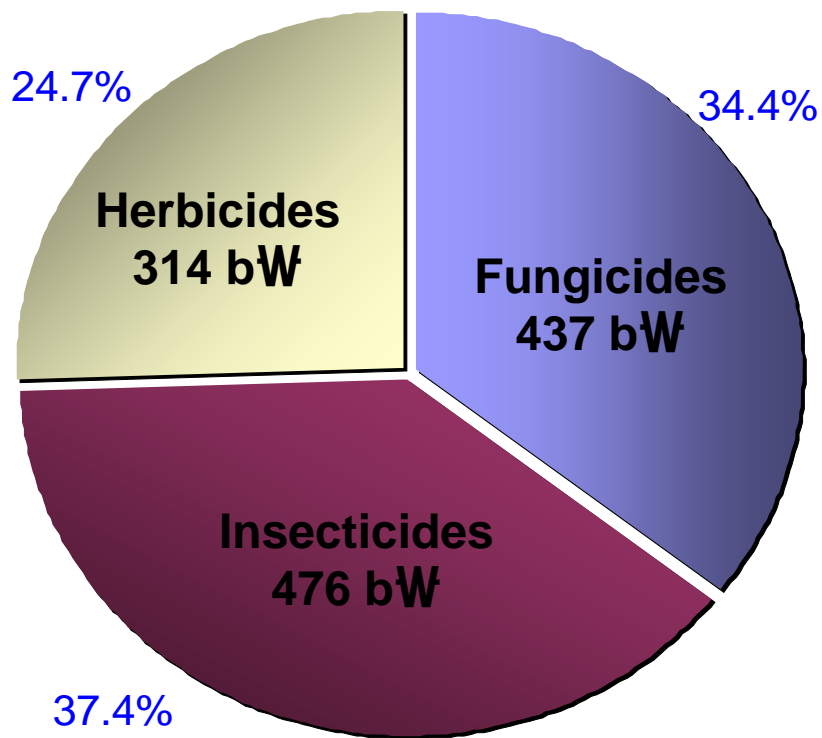


Sources: Cropnosis (2007)

## Leading Company (2004)

	Company	Sales (USD M)	M/S	R/D (USD M)	R&D as % of Sales
1	Bayer CropScience	7,002	21.60%	738	10.5
2	Syngenta	6,030	18.60%	499	8.3
3	BASF	4,167	12.90%	339	8.1
4	Dow AgroSciences	3,133	9.70%	240	7.7
5	Monsanto	2,744	8.50%	96	3.5
6	DuPont	2,211	6.80%	243	11
7	Sumitomo Chemical	1,358	4.20%	113	8.3
8	Makhteshim-Agan	1,358	4.20%	19	1.4
9	Nufarm	1,180	3.60%	54	4.6
10	Arysta	791	2.40%	20	2.5
11	FMC	704	2.20%	71	10.1
12	Cheminova	492	1.50%	43	8.7
13	Ishihara	362	1.10%	41	11.3
14	Sipcam-Oxon	347	1.10%	10	2.9
15	Kumiai	338	1.00%	22	6.6
<b>Total</b>		<b>32,349</b>	<b>100%</b>	<b>-</b>	<b>-</b>

## Sectors (2006)



**Total 1,272 b₩**

## Leading Company (2006)

	Company	Sales (b₩)	M/S
1	Dongbu Hannong	300	23.6
2	KyungNong	185	14.5
3	Dongbang	128	10.0
4	Youngil	125	9.8
5	Syngenta	122	9.6
6	Bayer	121	9.5
7	Samkong	118	9.3
8	Dongbu Fine Chem.	71	5.6
9	Sungbo	58	4.6
10	SMBT	19	1.5
	Others	27	2.1
	<b>Total</b>	<b>1,272</b>	<b>100</b>

Sources: KCPA (2006)

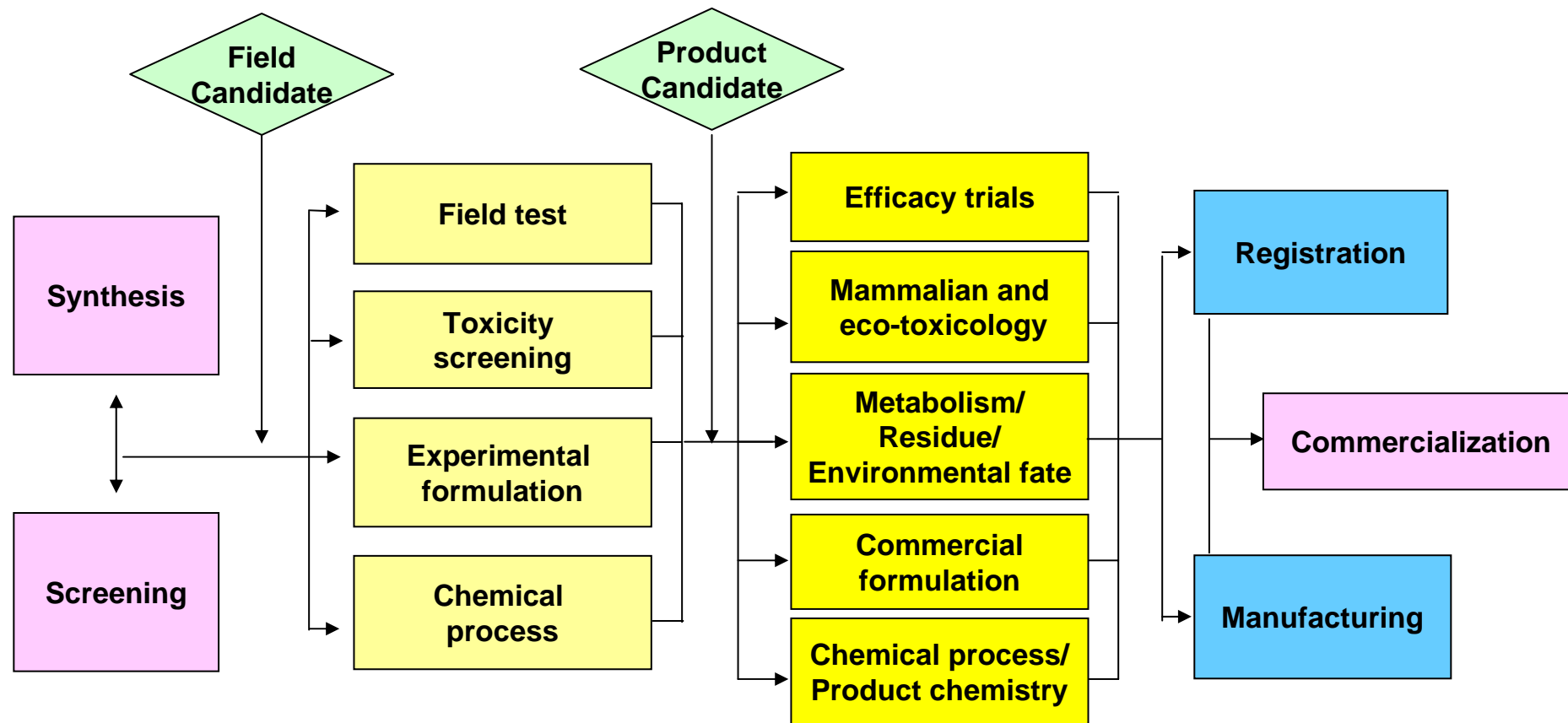
						(US M\$)
2005 Ranking	Country	2004 Sales	2005 Sales	Sales Growth ( '05/'04)	Average M/S (%)	
1 (1)	USA	6,938	7,248	4.5%	21.8	
2 (3)	Brazil	4,494	4,244	-5.6%	13.4	
3 (2)	Japan	3,093	2,989	-3.4%	9.3	
4 (4)	France	2,233	2,323	4.0%	7.0	
5 (5)	China	1,895	2,043	7.8%	6.0	
6 (6)	Germany	1,372	1,364	2.8%	4.1	
7 (12)	Australia	1,199	1,151	-4.0%	3.6	
8 (7)	Canada	1,022	1,105	8.1%	3.3	
9 (8)	South Korea	838	920	9.8%	2.7	
10 (9)	Italy	903	919	1.8%	2.8	
World		32,349	32,867	1.6%	100.0	

Sources: Cropnosis (2007)

\*Figures in ( ) indicate 2003 ranking

Discovery Research: Optimization (2-3 yrs)

Development (5~8 yrs)



Probability: 1/30,000

(Designed by Dr. S.J. Koo)



## □ Market Governance = Low Price / High Activity / Multi-function

Class	Leading Products	Manufacturer	Volume (M. won)	Characteristics
Fungicide	fluazinam WP	DHT	10,100	Broad spectrum / Protectant
	polyoxin-B WP	DCC	9,300	Anti-biotics /Protecting&Curing effect
	tebuconazole WP	Bayer	9,000	Broad spectrum / Protecting&curing effect
	hexaconazole EC	SamKong	8,100	Protecting&curing effect
	azoxystrobin SC	Syngenta	8,000	Strobilurins
Insecticide	emamectin benzoate EC	Syngenta	14,100	Broad spectrum
	imidacloprid WP	DHT	13,200	Aphids(Foliar app.)
	carbofuran GR	Youngll	10,000	Low Price, Broad spectrum soil treatment
		DHT	9,700	
	imidacloprid GR	Bayer	7,700	Neo-Nicotinoid, Aphids
	KyungNong	7,300	Low price, Lepidoptera spp	
Herbicide	paraquat dichloride SL	DHT	16,000	Non-selective
		Syngenta	12,800	
	glyphosate SL	DHT	11,000	Non-selective
	mefenacet + imazosulfuron SC	DHT	8,400	Rice / Labor-saving
	pyrazosulfuron-ethyl + molinate GR	Bayer	8,100	
	DHT	6,900	Rice / Low price	



우수농산물인증



농산물이력추적관리

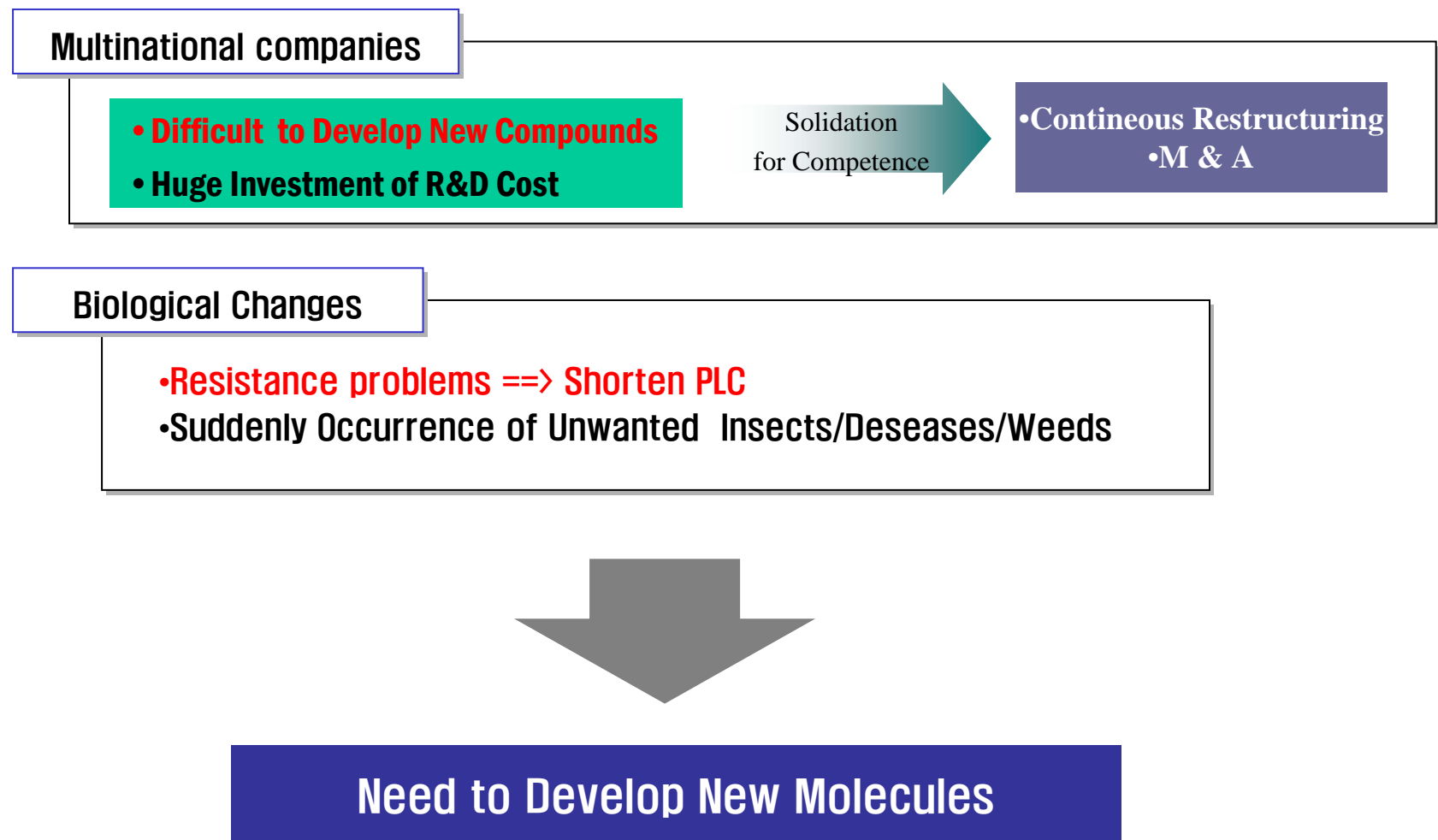
□ Quality Control Law of Agriculture products(2005 Revised)

- GAP Starting from 2006
- **10% Increase of CAGR upto 2013년**



**Low Toxic ∞ Safe**

- Eco- & Mammalian Toxicity / Residue
- Registration

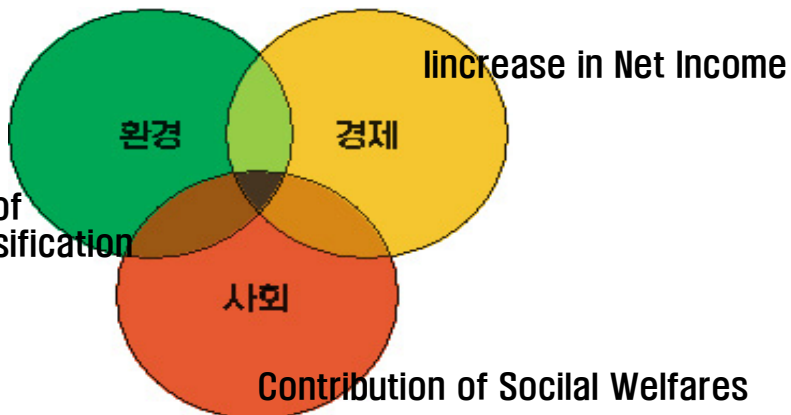


## GAP & Environment-Friendly Agriculture

Stable Food Production on Economical/Safe/Qualitative Point of View

Optimization of Natural Resource Management

Conservation of Species' diversification

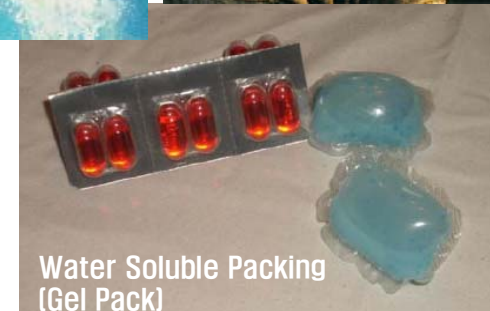
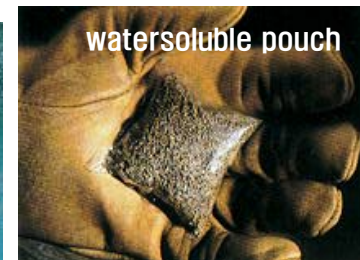


==> Concentration of New Technologies

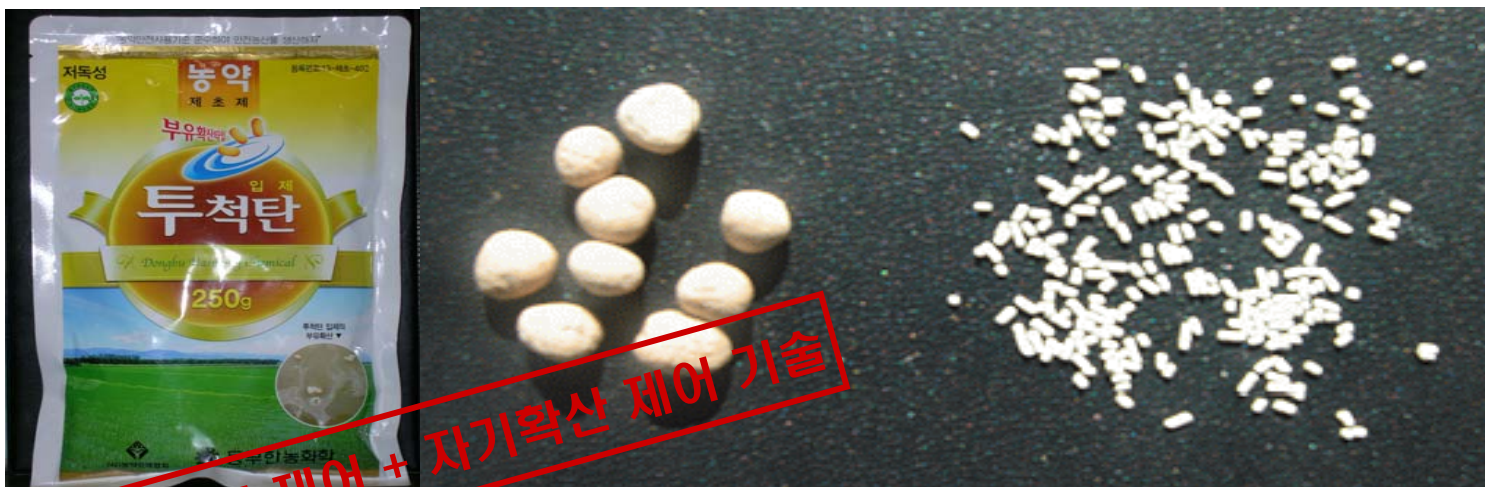


## New Formulation [Safe & Labor-saving]

- Light & Labor-saving Formulation
- Safety
- Decrease in Application Dose
- One-packed formulation
- Decrease in spray volume
- Optimization of Biological Efficacy
- Controlled-release Formulation



## □ New formulations



방출속도 제어 + 자기확산 제어 기술

### New Type

### Conventional Type

Application Dose(Kg/ha)

2.5

30

Granule size (mm)

3 ~ 8

0.7 ~ 0.9

No of Granules/g Product

8 ~ 15

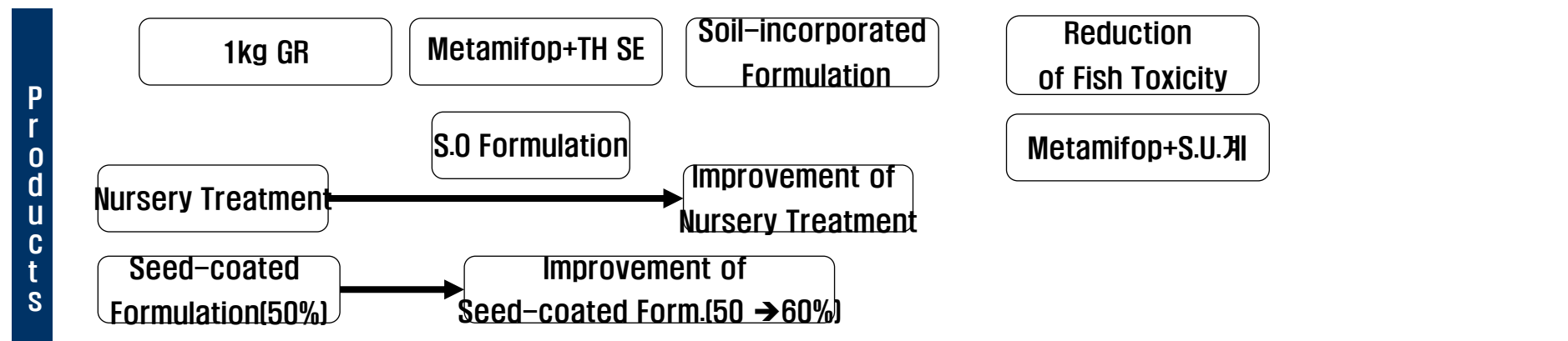
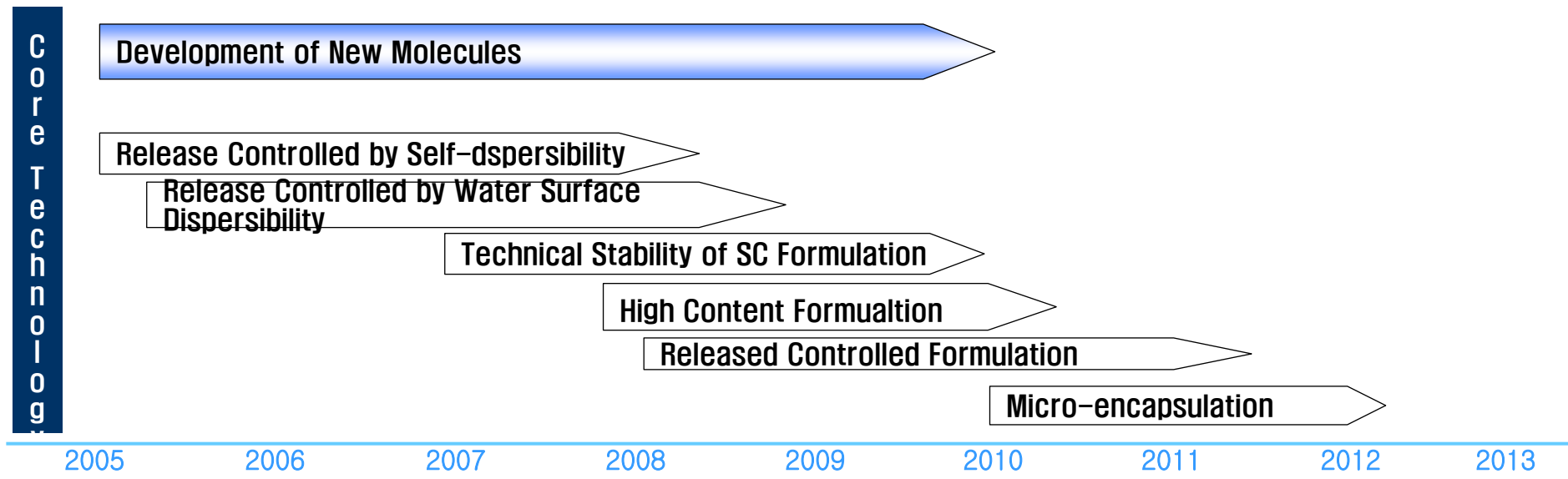
600 ~ 2400

No. of Granules/m<sup>2</sup>

2 ~ 4

1800 ~ 7200

## □ New Formulation

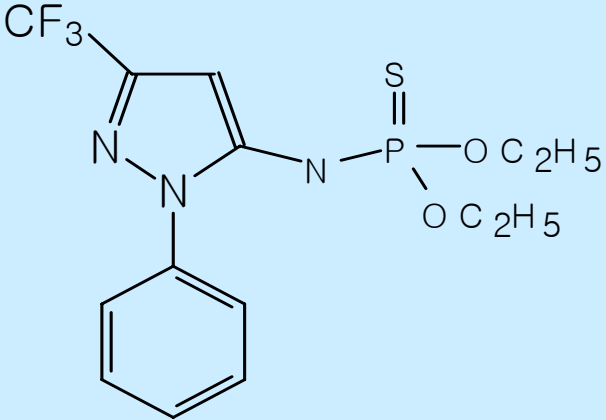


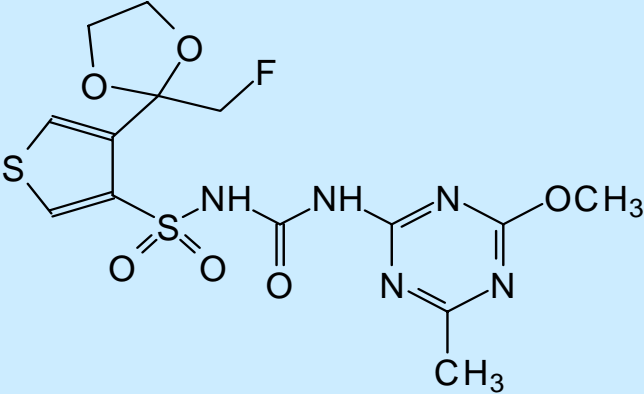
Institution	Sponsors	Since
Korea Research Institute of Chemical Technology (KRICT)	Ministry of Science and Technology Ministry of Agriculture and Forestry POSCO Chemical LGLS Hanwha, Hyundai DHT Sungbo Chemical KyungNong Dong-O Chemical	1982
LG Life Sciences (LGLS)	LGLS	1990
Dongbu Hitek (DHT)	DHT	1997

\* International patent law for biological active small molecule was introduced in 1987 in Korea

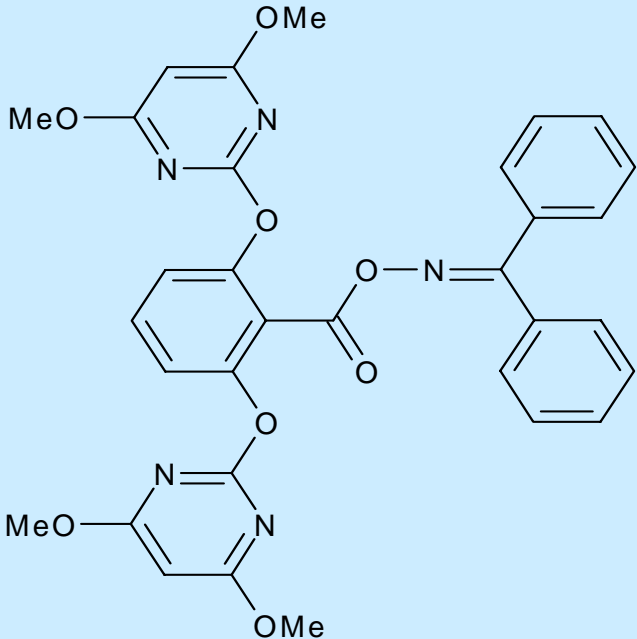
Compound name	Usage	Inventor	Developmental status
Flupyrazofos	Insecticide	KRICT	Registered (1996) Discontinued afterward
K12060	Herbicide	KRICT	Licensed to Zeneca (1995) Discontinued (1997)
Pyribenzoxim	Herbicide	LGLS	Commercialized (1997)
Ethaboxam	Fungicide	LGLS	Commercialized (1999) Registration applied in EU (2003)
Flucetosulfuron	Herbicide	LGLS/KRICT	Commercialized (2005)
Bistrifluron	Insecticide	DHT/KRICT	Commercialized (2006)
Metamifop	Herbicide	DHT/KRICT	Registration in Korea(2007) & Japan (2010)



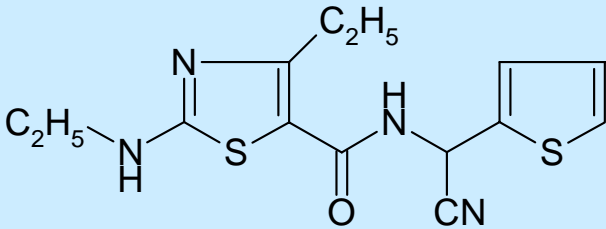
Structure	Usage	• Insecticide
	Characteristics	• Very effective and specific to Diamond Back moth
	Mode of action	• Acetylcholinesterase inhibition
	History and Developmental status	<ul style="list-style-type: none"> <li>• Discovered in 1989 by KRICT</li> <li>• Licensed to Sungbo Chemical in 1991</li> <li>• Registered in 1996 : First new pesticide registered in Korea</li> <li>• Discontinued</li> </ul>

Structure	Usage	<ul style="list-style-type: none"> <li>• Selective herbicide for winter cereals</li> </ul>
	<b>Characteristics</b>	<ul style="list-style-type: none"> <li>• Post-emergence herbicide</li> <li>• Broad spectrum: Control of <i>Alopecurus myosuroides</i> plus various broadleaf weeds including <i>Galium aparine</i></li> <li>• Low use rate: &lt;20 g ai/ha</li> </ul>
	<b>Mode of action</b>	<ul style="list-style-type: none"> <li>• ALS inhibition</li> </ul>
	<b>History and Developmental status</b>	<ul style="list-style-type: none"> <li>• Discovered in 1992 by KRICT</li> <li>• Licensed to Zeneca in 1995</li> <li>• Discontinued in 1997</li> </ul>

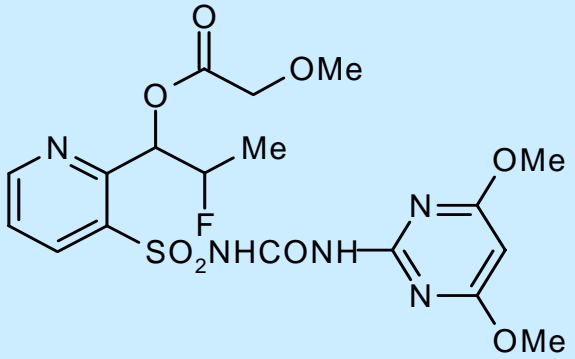
## The First New Herbicide in KOREA

<b>Name</b>	Common: Pyribenzoxim Code: LGC-40863 Brand: PYANCHOR™	<b>Usage</b>	• Selective rice herbicide
	<b>Structure</b>	<b>Characteristics</b>	• Post-emergence Herbicide • Broad spectrum • Wide application window • Application Rate: 20 ~ 50 g ai/ha
<b>Mode of action</b>			• ALS inhibition
 <p>The chemical structure of Pyribenzoxim consists of a central benzene ring substituted at the 1, 3, and 5 positions with 2,4,6-trimethoxyphenyl groups. At the 4-position of the benzene ring, there is a carbonyl group (-C(=O)-) which is linked via an oxygen atom to a nitrogen atom. This nitrogen atom is double-bonded to a biphenyl group (two benzene rings connected at the 1-positions).</p>		<b>History and Developmental status</b>	• Discovered by LG Chemical in 1993 • Launched in Korea in 1997: <b>(The First new pesticide commercialized in Korea)</b> • Global development (entry year) - China (00), Vietnam (01), Panama (02), Thailand (03) - Latin America, Malaysia, Sri Lanka etc: 04~06

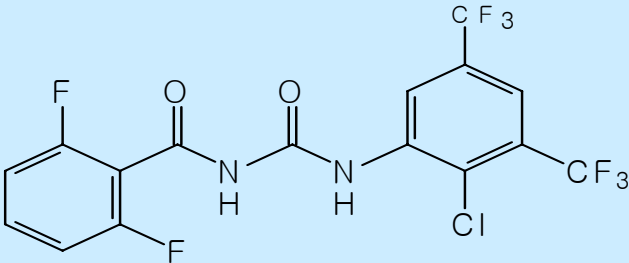
## The First New Fungicide in KOREA

Name	Common: Ethaboxam Code: LGC-30473 Brand: GUARDIAN <sup>TM</sup> TELLUS <sup>TM</sup>	Usage	<ul style="list-style-type: none"> <li>Oomycetes fungicide to control downy mildew and late blight</li> </ul>
	Structure	Characteristics	<ul style="list-style-type: none"> <li>Curative</li> <li>Translaminar</li> <li>Systemic</li> <li>Application rate: 100 ~ 250 g ai/ha</li> <li>Novel chemistry</li> <li>Low risk of resistance development</li> </ul>
Mode of action			<ul style="list-style-type: none"> <li>Inhibition of tubulin polymerization</li> <li>Inhibition of oxidative respiration</li> </ul>
		History and Developmental status	<ul style="list-style-type: none"> <li>Discovered by LG Chemical in 1993</li> <li>Launched in 1999 in Korea</li> <li>Registration applied to EU in 2003</li> <li>EU registration expected in 2007</li> </ul>

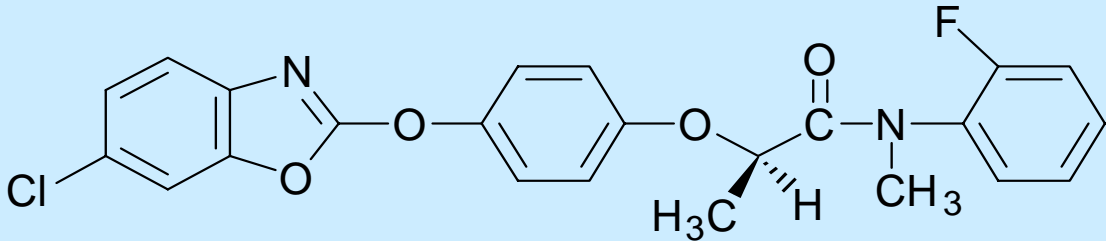
## A flexible new component in rice herbicide systems

Name	Common: Flucetosulfuron Code: LGC-4213 Brand: FLUXO™	Usage	<ul style="list-style-type: none"> <li>• Selective herbicide for rice, winter cereals, and turfgrass</li> </ul>
	Structure	Characteristics	<ul style="list-style-type: none"> <li>• Pre and Post-emergence herbicide</li> <li>• Broad spectrum: Barnyardgrass, Sedges, and BL weeds</li> <li>• Wide application window</li> <li>• Low use rate: 10~30 g ai/ha</li> </ul>
Mode of action			<ul style="list-style-type: none"> <li>• ALS Inhibition</li> </ul>
		History and Developmental status	<ul style="list-style-type: none"> <li>• Discovered jointly by LG Life Sciences and KRICT in 1999</li> <li>• Launched in 2004 in Korea</li> <li>• In development in Japan, Europe, and USA</li> </ul>

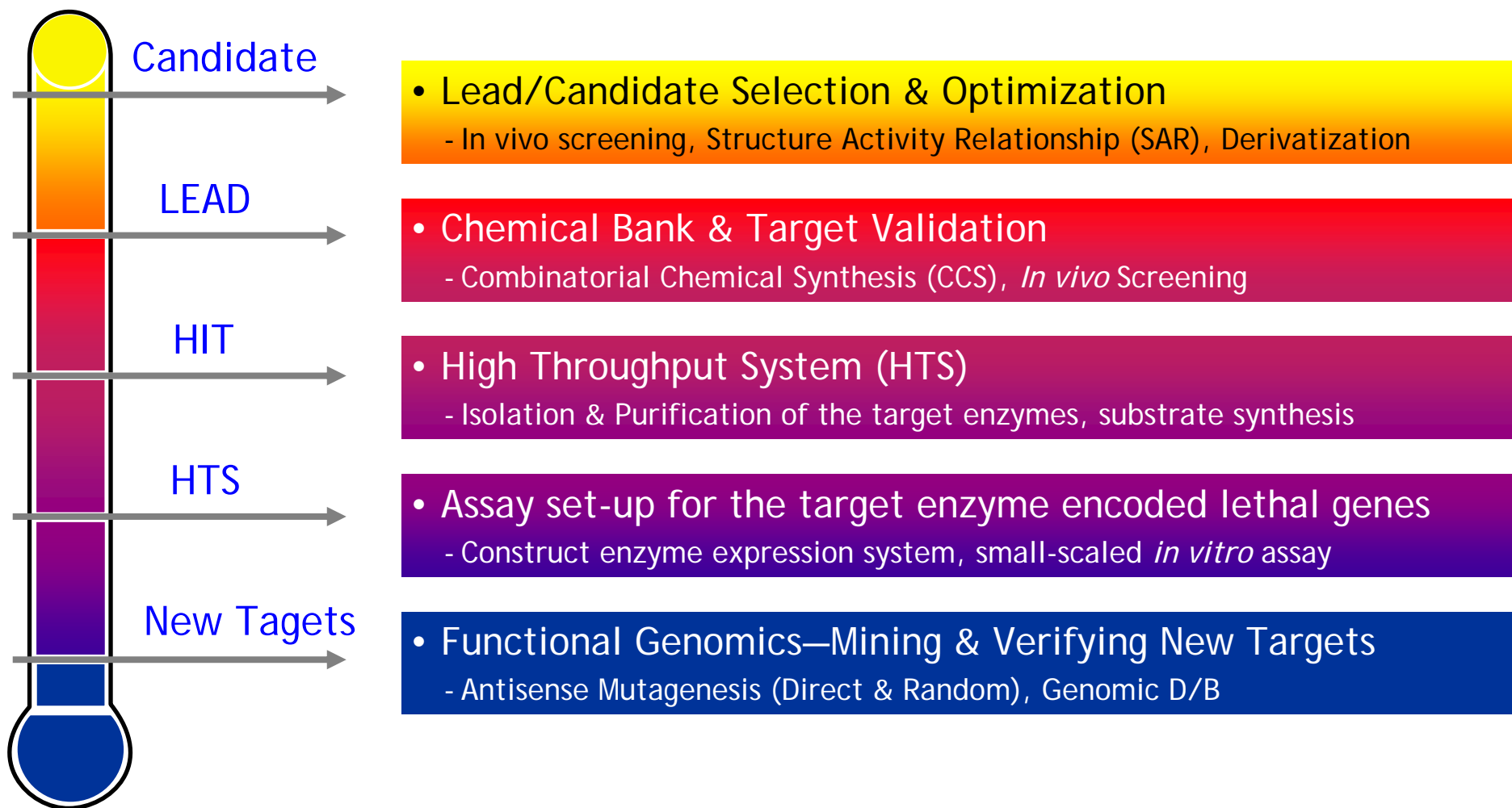
## The First New Insecticide in KOREA

Structure	Usage	• Insecticide
	<b>Characteristics</b>	<ul style="list-style-type: none"> <li>• Broad spectrum</li> <li>• Particularly strong to <i>Lepidoptera</i> Whitefly and Termite</li> <li>• Rate: 50 ~ 400 g ai/ha</li> </ul>
	<b>Mode of action</b>	<ul style="list-style-type: none"> <li>• IGR (Chitin biosynthesis inhibitor)</li> </ul>
	<b>History and Developmental status</b>	<ul style="list-style-type: none"> <li>• Discovered by HanHwa (1995)</li> <li>• Developed by DHT (1998)</li> <li>• Commercialized in 2006 in Korea</li> <li>• Under global development                             <ul style="list-style-type: none"> <li>- Asia: Thailand, India, Malaysia</li> <li>- South America: Brazil, Columbia, Mexico, Argentina</li> </ul> </li> </ul>

## A grasskiller with excellent rice safety

<b>Structure</b>	
<b>Usage</b>	<ul style="list-style-type: none"> <li>• Selective herbicide for rice, turf, and dicotyledonous crops</li> </ul>
<b>Characteristics</b>	<ul style="list-style-type: none"> <li>• A grasskiller for post-emergence</li> <li>• Available for both soil and foliar application in direct-seeded and transplanted rice cultivation</li> <li>• Excellent rice safety</li> <li>• Rate: 100 ~ 200 g ai/ha</li> <li>• Barnyardgrass up to tiller stage controlled excellently</li> </ul>
<b>Mode of action</b>	<ul style="list-style-type: none"> <li>• ACCase inhibition</li> </ul>
<b>History and Developmental status</b>	<ul style="list-style-type: none"> <li>• Discovered by KRICT in 1995</li> <li>• Developed by DHT in 1997</li> <li>• Registration in 2007 w/ Trade name of "Pyzero"</li> <li>• In global development including Japan, LA and VT</li> </ul>

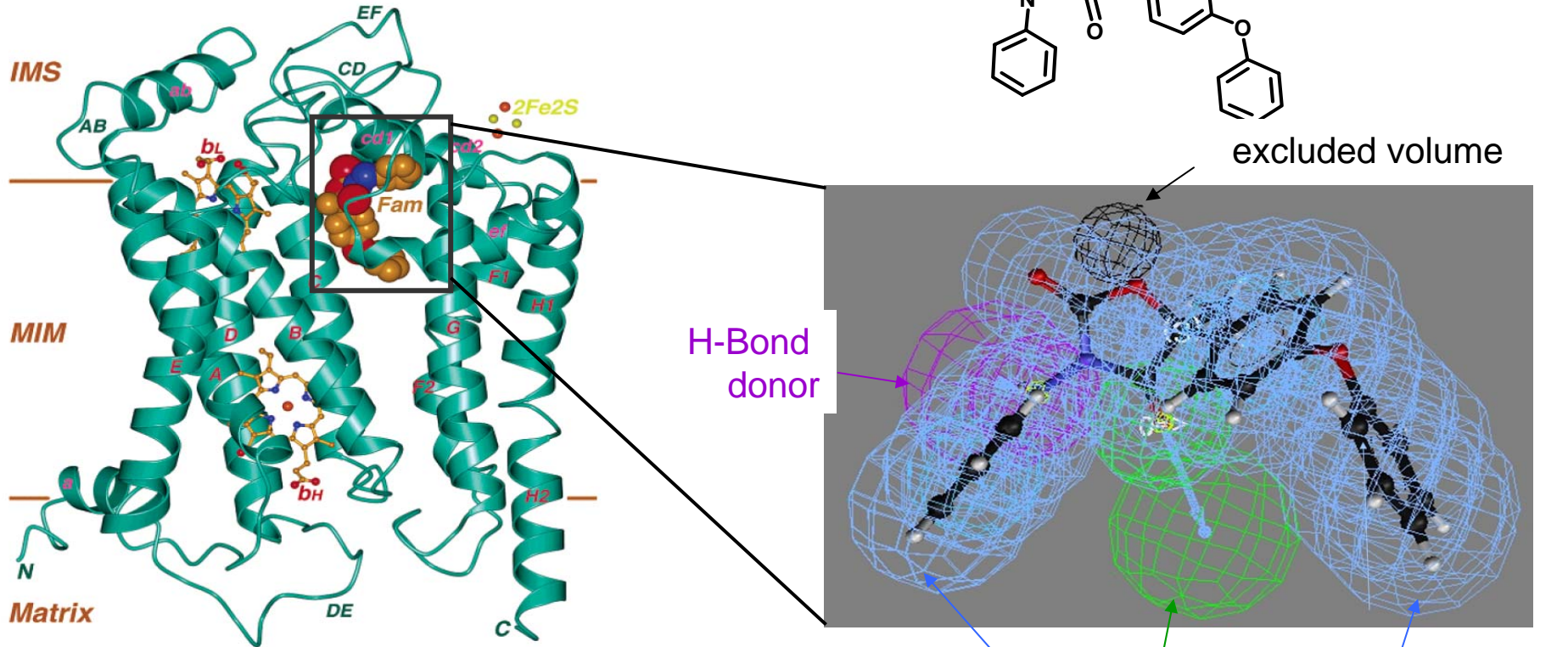
## Participants: Genomine Inc. ▪ KRICT ▪ KIST



(Provided by Dr. D.H. Lee)



# Participants: KRICT ▪ KyungNong ▪ KTR

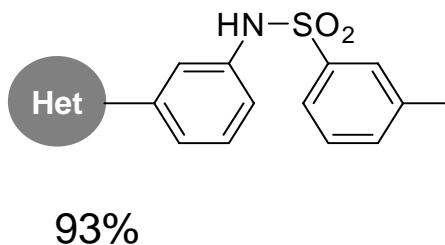
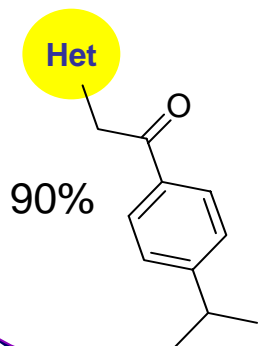
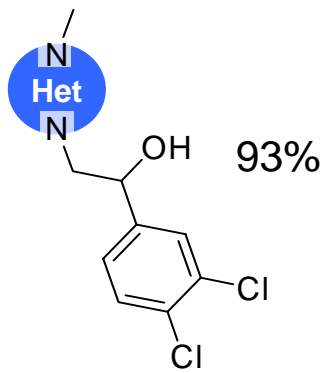
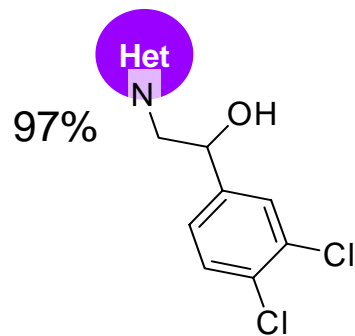


Binding Mode of Famoxadone on Cytochrome bc1 Complex

(Provided by Dr. B.T. Kim at KRICT)

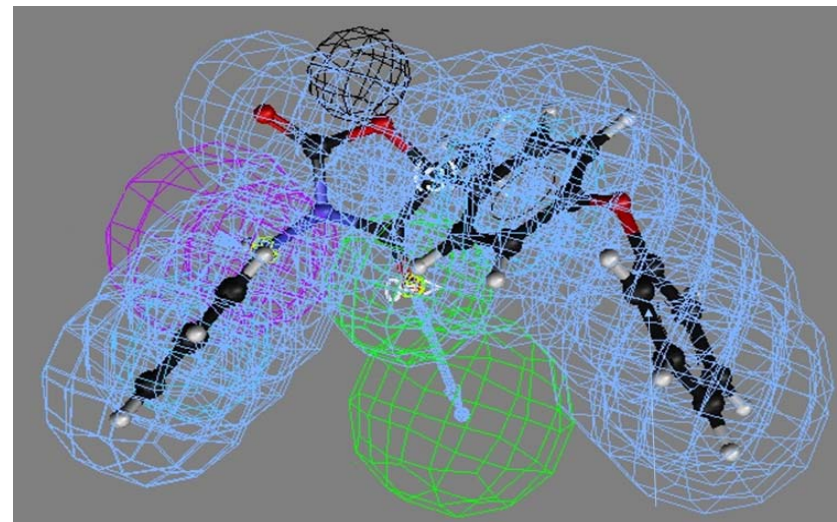
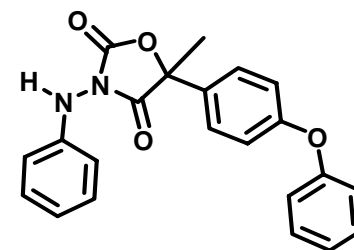
## Hits from Commercially Available Agents

TLB activity at 100 ppm



4 hits

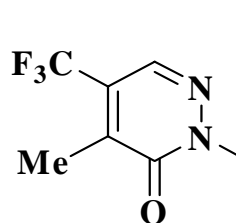
~200 compounds



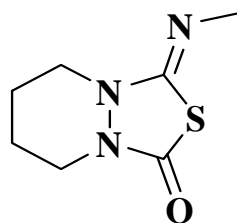
(Provided by Dr. B.T. Kim at KRICT)

## Participants: Dongbu Hitek ▪ LGLS ▪ KRICT

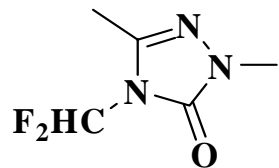
## Head



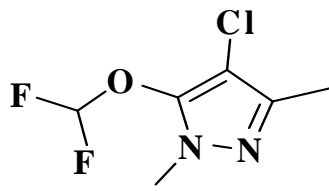
Pyridazinone



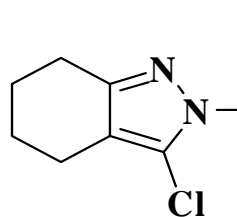
Thiazolopyridazine



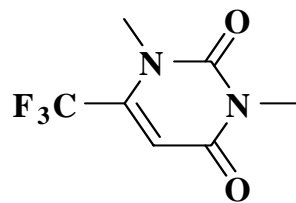
Triazolinone



Pyrazole

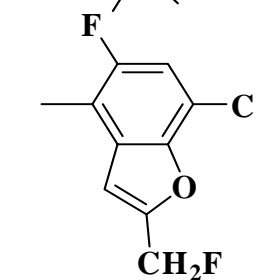
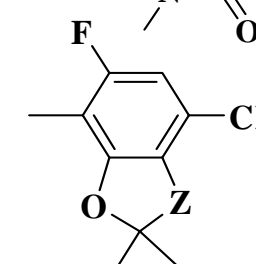
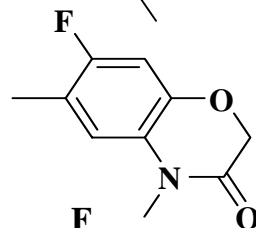
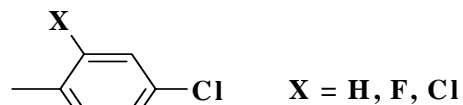


Indazole

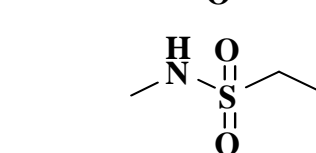
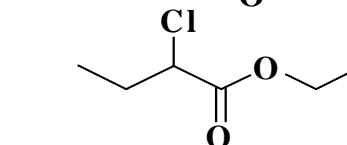
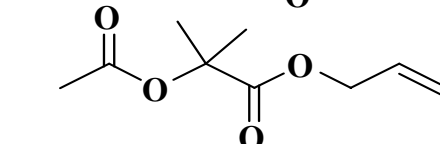
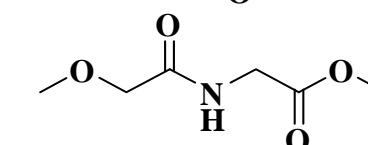
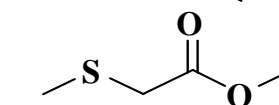
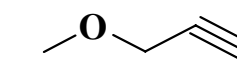
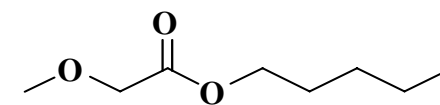


Uracil

## Bridge



## Tail



- ❖ In Korea, efforts to develop new agrochemicals have been made for 20 years
- ❖ Several new molecules were discovered and, out of them, **Pyribenzoxim, Fluceotusulfuron, Ethaboxam, Bistrifluron** were commercialized and **Metamifop** is just about to launch in the market
- ❖ A nation-wide collaboration project is underway among industry, academia, and independent research institutes
- ❖ With all experiences and collaborations, overall potential to discover and develop further new agrochemicals is very high and optimistic in Korea

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