Cultivos Transgenicos: mitos, impactos ambientales y alternativas agroecologicas

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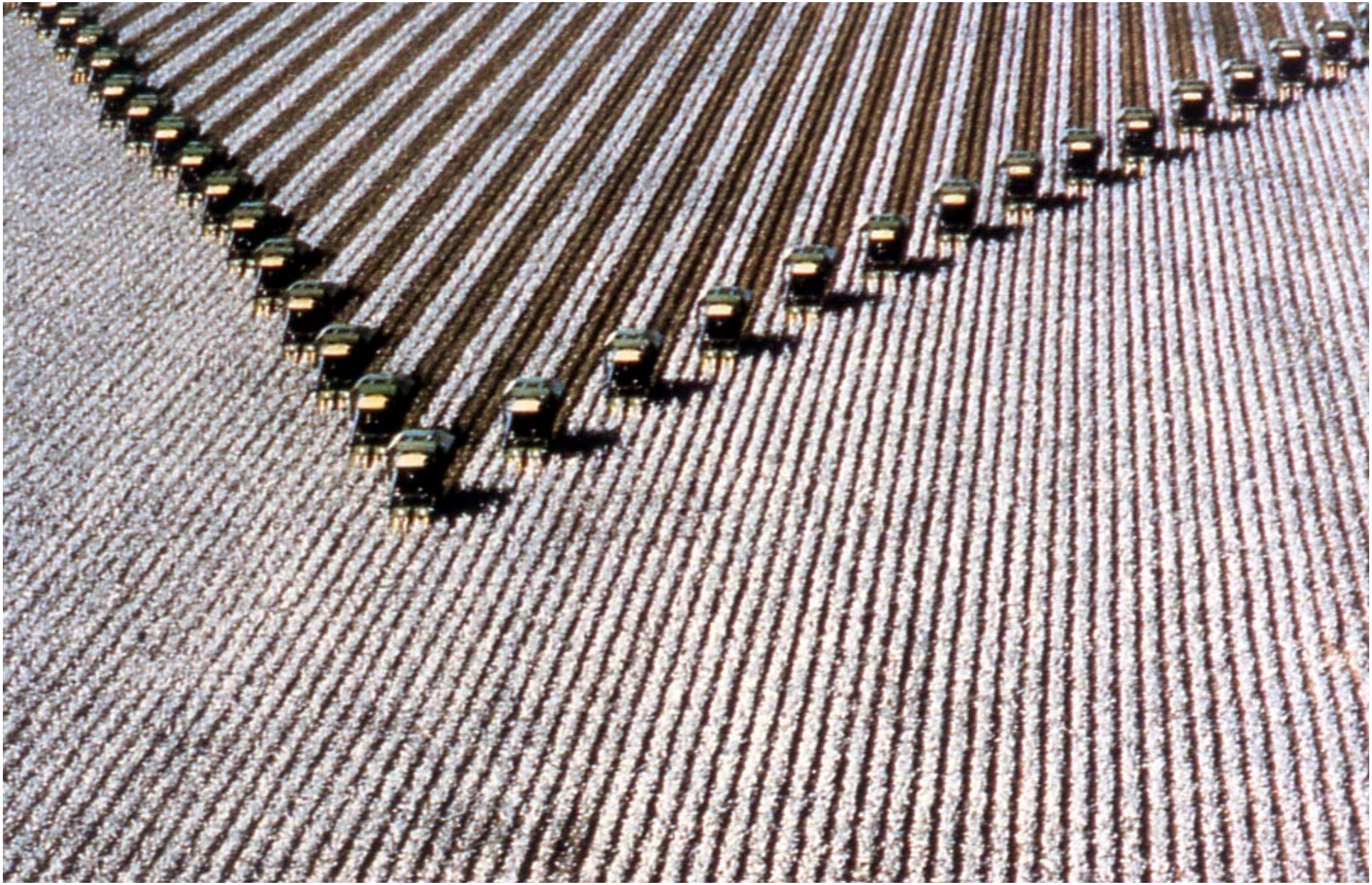
The expansion of modern agriculture

- Worldwide cropland increased in 50 years from 265 million hectares to 1,5 billion today
- These lands are planted to 12 species of grain crops, 23 vegetable species and 35 fruit and nut species
- 91% of cropland devoted to monocultures of cotton, maize,wheat, rice and soybeans



The success of modern agriculture

- More cereals and animals per hectare (globally tripling of cereal production in last 50 years)
- UK wheat yields rose from 2,5 to 8 t/ha
- more food produced by very few people; < 2 % population are farmers in USA
- more meat and milk per animal
- USA: dairy cows-8,000 kg milk/yr -up 3 X in 50 years

Global Pesticide Consumption

- 67% global increase in pesticide use from 1983-1998
- US $34.1 billion dollars in 1998
- 138% increase in pesticide use in Latin America same period
- 4.1 billion pounds applied annually

The futile chemical warfare against pests

- More than 450 species of arthropods resistant to > 1000 different pesticides
- US agricultural losses to pests reached 32% between 1942-50 and 37% between 84-90
- environmental and social costs of pesticide use reaches 8 billion annually in the USA
- 1999 FDA found pesticide residues in 60% fruits, 29% seafood, 29% vegetables, 38% grain products.

The Top 8 pesticide producers

Company	Pesticide Sales** (in million US$)
1. Syngenta (Switzerland)*	6,410
2. Aventis CropScience (France)	4,320
3. BASF (Germany)*	3,525
4. Monsanto (USA)	3,214
5. Bayer (Germany)	2,316
6. DuPont (USA)	2,099
7. Dow AgroSciences (USA)	2,088
8. Makhteshim-Agan (Israel)	720

* Pro forma sales for companies that merged in 2000, unadjusted for divestments required by competition authorities.

** World wide in 1999; figures do not include seed sales.

Source: Wood Mackenzie, personal communication.

The Top 11 in the seed industry

Company	Parent company/companies	Seed Sales* (in million US$)
1. Pioneer Hi-Bred (USA)	DuPont	1,850
2. Monsanto (USA)	Pharmacia	1,700
3. Syngenta (Switzerland)	Novartis and AstraZeneca	947
4. Limagrain (France)		700
5. Seminis (USA)	SAVIA/Grupo Pulsar	531
6. Advanta (Netherlands)	Cosun and AstraZeneca	416
7. Sakata (Japan)		396
8. KWS Saat AG (Germany)		355
9. Dow AgroSciences (USA)	Dow Chemical	est. 350
10. Delta & Pine Land (USA)		301
11. Aventis CropScience (France)	Aventis	288

* World wide in 1999.

Source: RAFI, 2000.

Myths of biotechnology

- Ecologically safe
- will promote chemically free agricutlure
- will lead to biodiversity conservation
- promotes gentler technologies
- Is essential to feeding the world
- will promote use of new chemicals, more lethal at low doses but safer to humans

Assumptions of biotechnology proponents

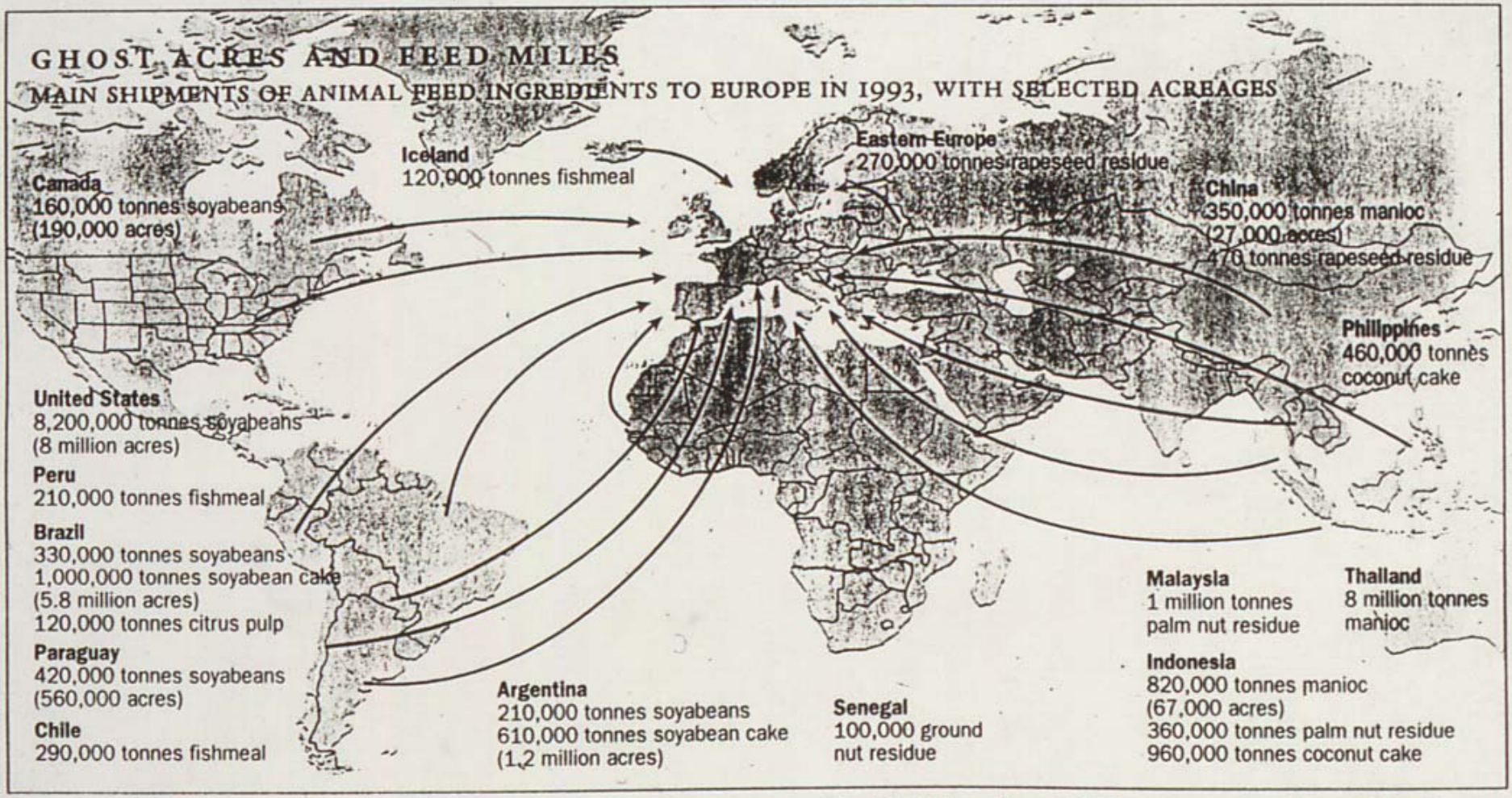
- People starve because of low food production
- Hunger will be solved by producing more food
- The only way to increase production is with biotechnology
- Agroecology and organic farming cannot meet world food demands

The truth about hunger

- Hunger is not caused by lack of genetic engineering to produce more food.
- Where hunger is prevalent there is an excess of staples
- Today there is enough food to provide every human being with 3500 calories per day, that is about 4.3 pounds every person every day.

ROOT CAUSES OF HUNGER

- Poverty: 1,5 billion people live on less than one dollar/day
- Unequal land distribution and mal distribution of food (lack of access to food and means to produce it)
- Best lands devoted to agroexports and much grain used as animal feed



This map shows acreage used by, mainly, developing countries to grow animal feed ingredients for European countries, and the distance they travel. Such a globalized system for feed (and food) production increases environmental degradation: from the terrible energy and pollution costs of increased ocean, air, and land transport to the pollution of local land and water caused by pesticide and machine intensive production. Hunger and malnutrition are on the upsurge in developing countries because land, once used to grow food for local populations, has been given over to export-driven, monocultural production, which grows food, feed and luxury commodities for wealthier countries.

Agriculture's Contribution to Economy

(Percentage in Selected Sub-Saharan African Countries)

Country	Employment in Agriculture	Contribution to Exports	Contribution to GDP
Burkina Faso	80	60	30
Côte d'Ivoire	70	80	-
Ethiopia	85	80	40
Kenya	75	70	30
Mali	80	-	46
Nigeria	70	-	30
Tanzania	90	80	50-60
Zimbabwe	26	40	13

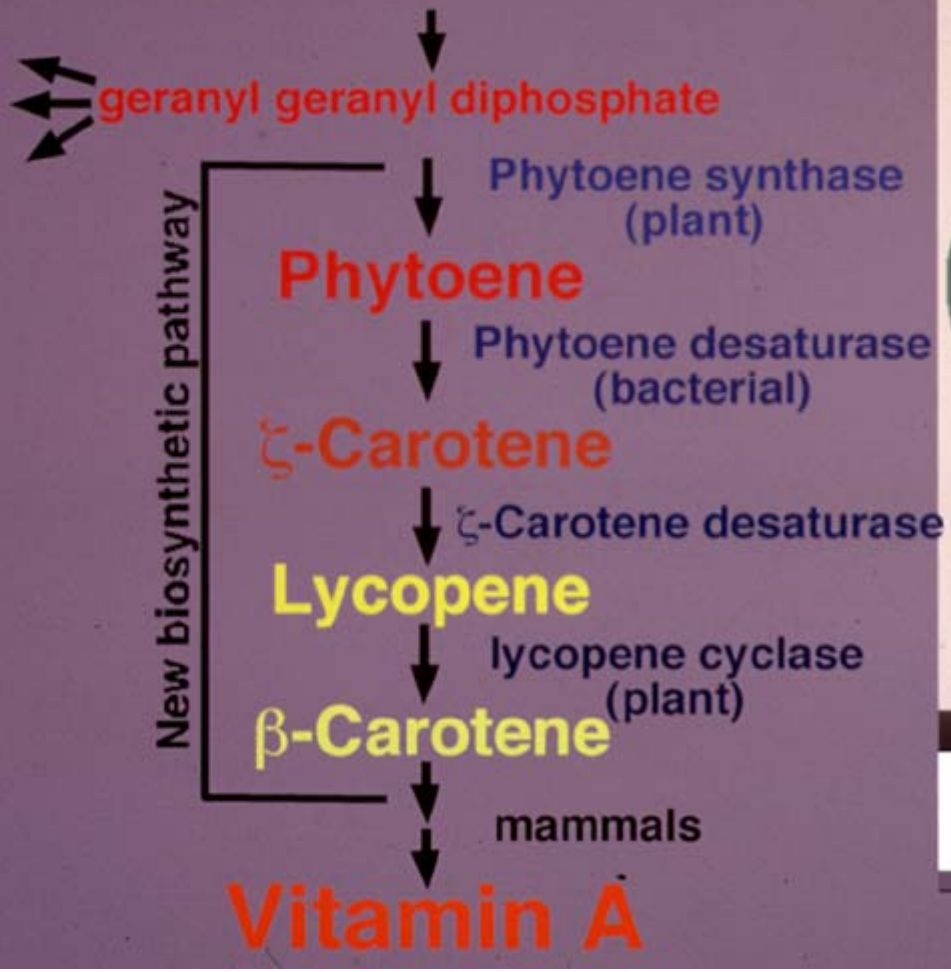
Source: Food and Agriculture Organization of the UN (FAO) 1999, 1994.

* projections

Globalization ,free trade and hunger

- In l986 Haiti imported 7,000 tons of rice (most grown in island)
- After “opening” its economy, rice flooded from USA (where is subsidized) first as food aid and then as part of free trade
- By 1996 Haiti imported 196,000 tons of rice at a cost of $100 million.
- Peasants were displaced, cost of rice went up, hunger increased

"what will this sister of mine do with rice?"
The winters tale 4.3



GOODIN PHOTO

Examples of beta-carotene sources

Food source	beta-carotene [microgram per gram fresh weight]
Refined red palm oil (as used as vitamin A supplement)	92.8
Carrot, raw	46-125
Leafy vegetable (32 types)	10-444
Sweet potato (orange variety)	11.4
Cassava (yellowish)	up to 7.9
Mango	up to 6.15
Papaya, watermelon	2.28-3.24
Golden Rice (Ye et al. 2000)	1.6

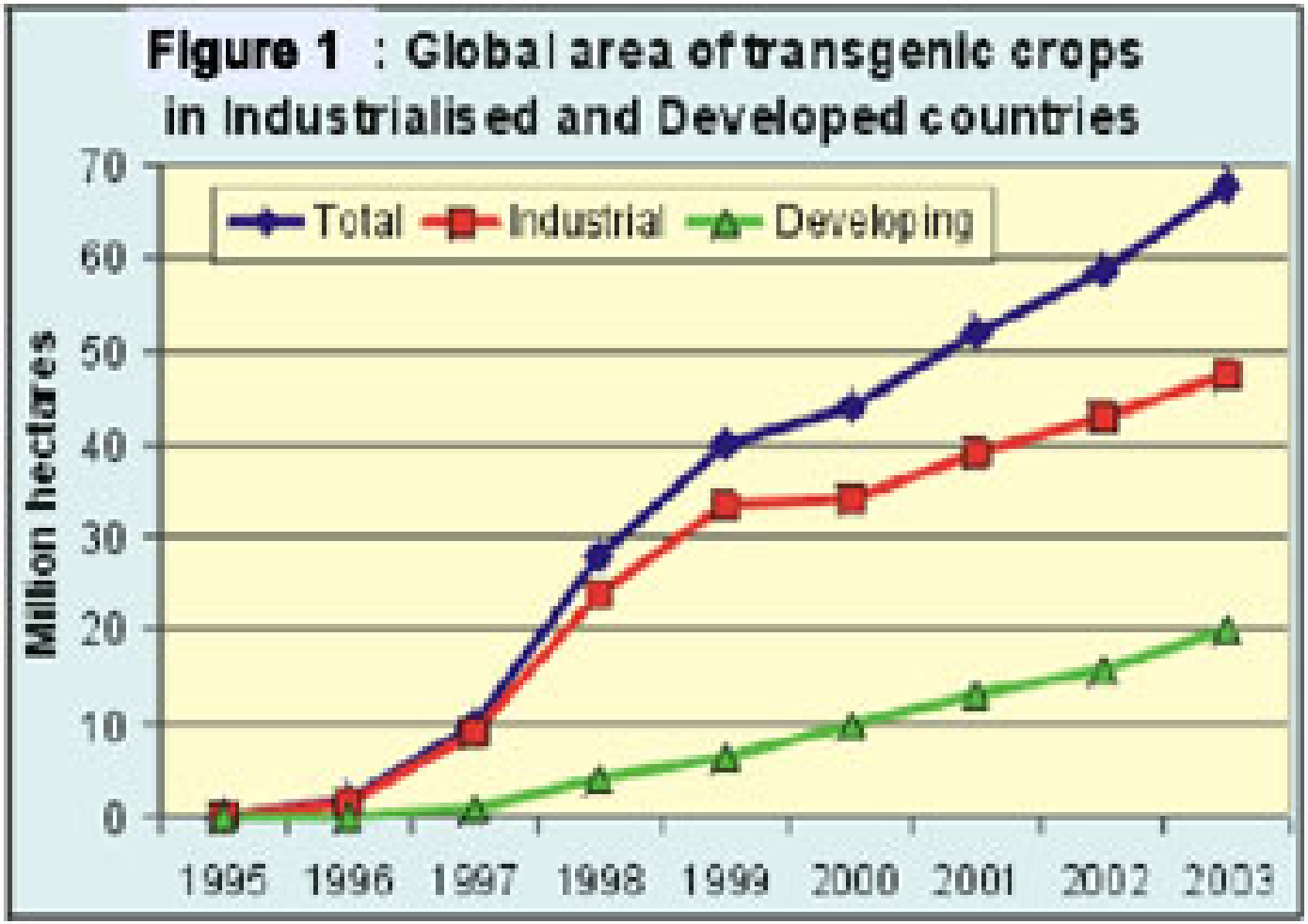
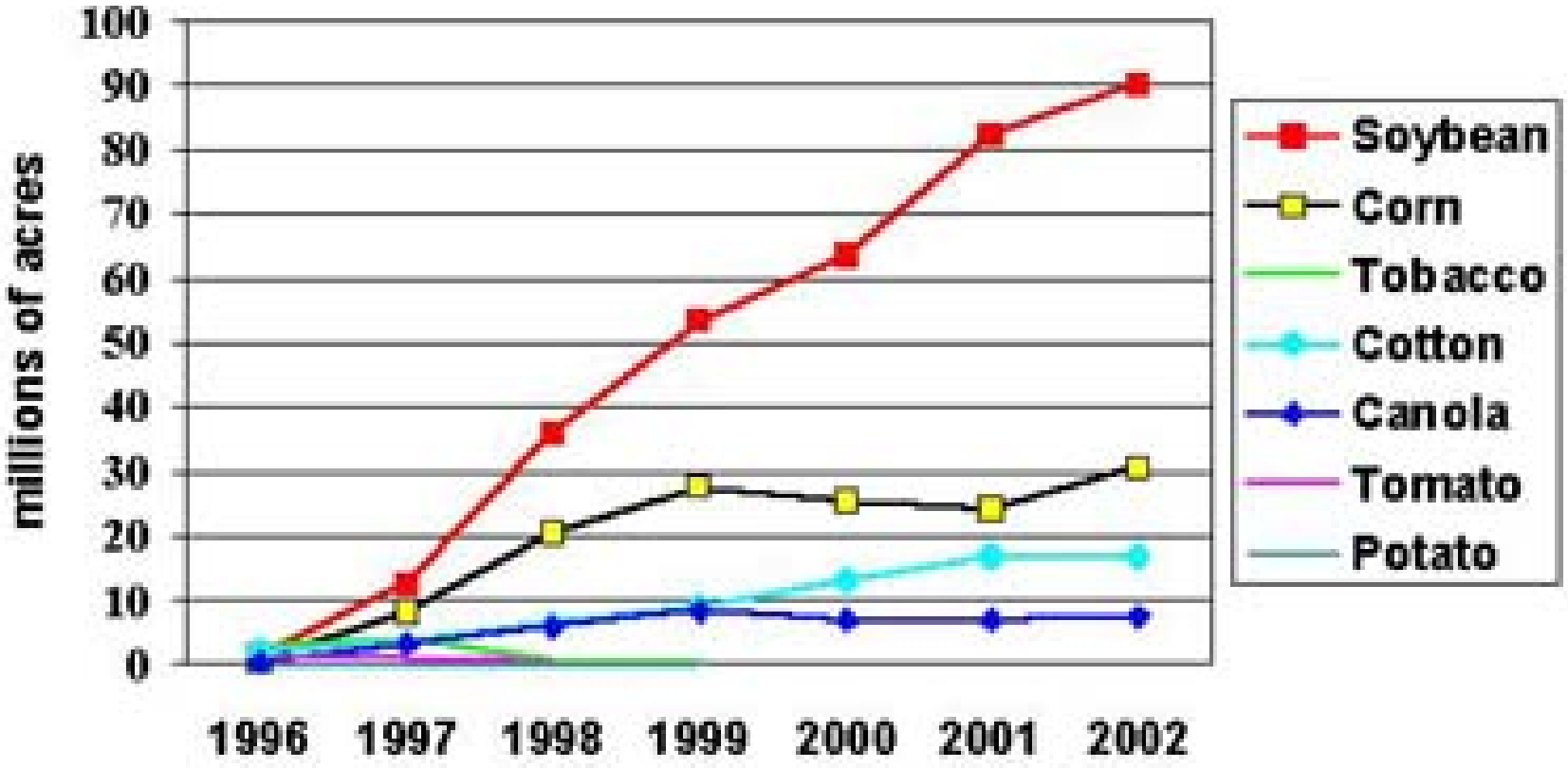
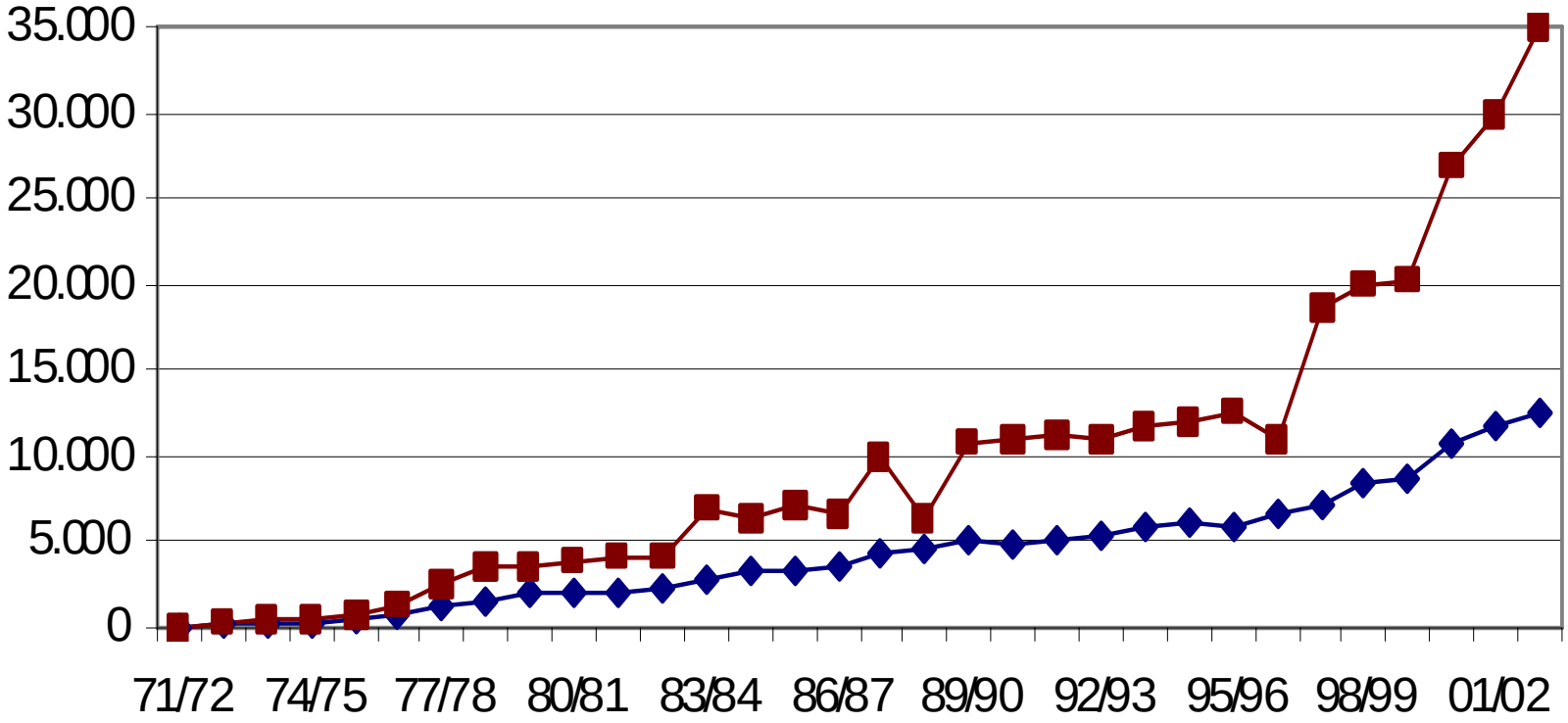


Figure 1 : Global area of transgenic crops in industrialised and Developed countries
Million hectares
70
60
50
40
30
20
10
0
Total
Industrial
Developing
1995
1996
1997
1998
1999
2000
2001
2002
2003

Global area of transgenic crops 1996-2002 by crop (millions of acres)



Soybean in Argentina (tons-red, has-blue)



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Situación 3. Soja Roundup Ready de 1° sobre Rastrojo de Maiz.

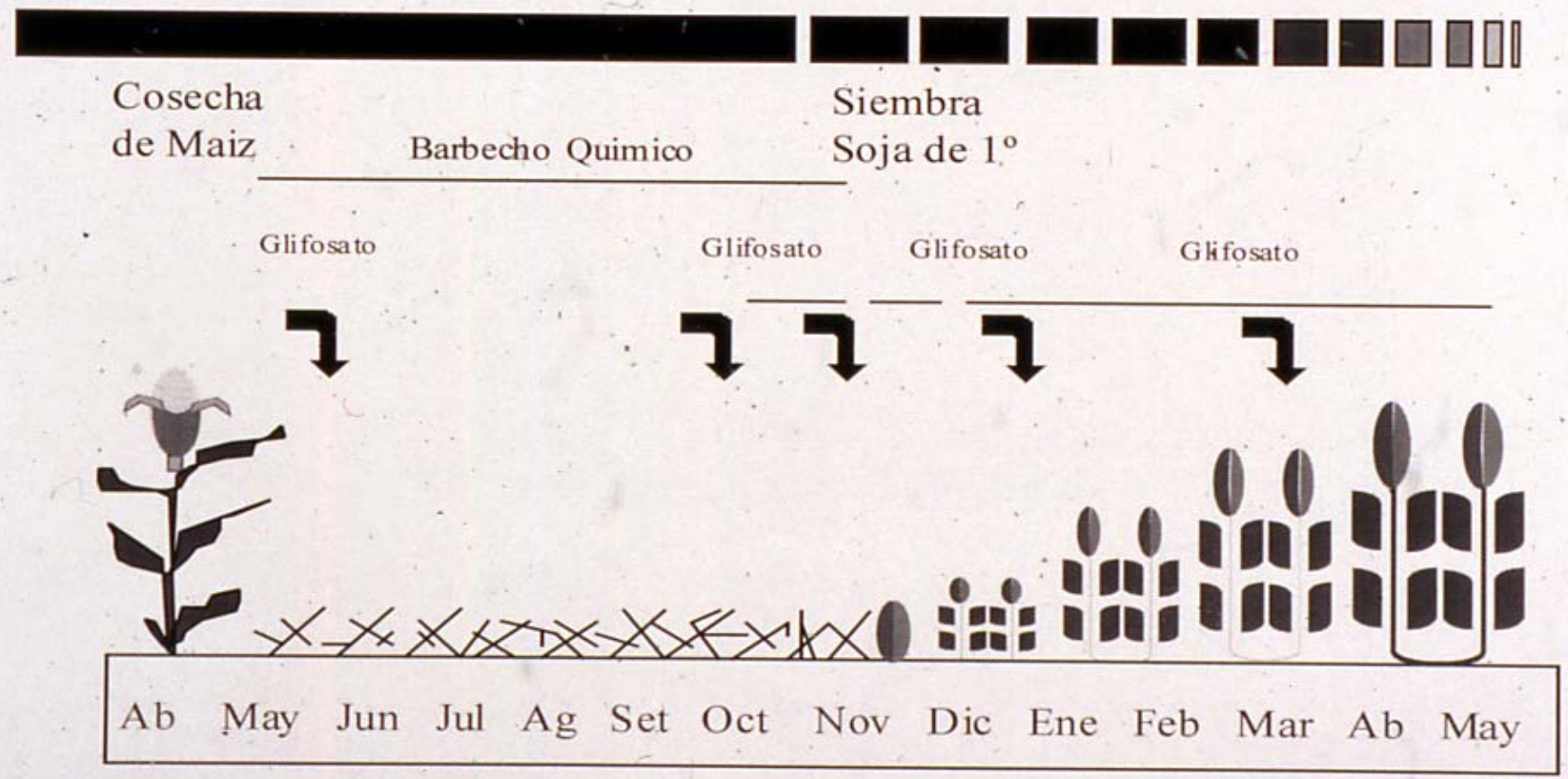

Diagrama N° 5

Fuente: Elaboración propia.

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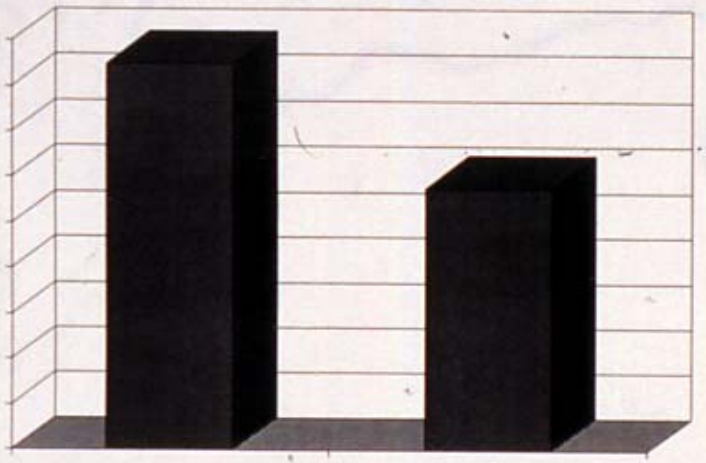
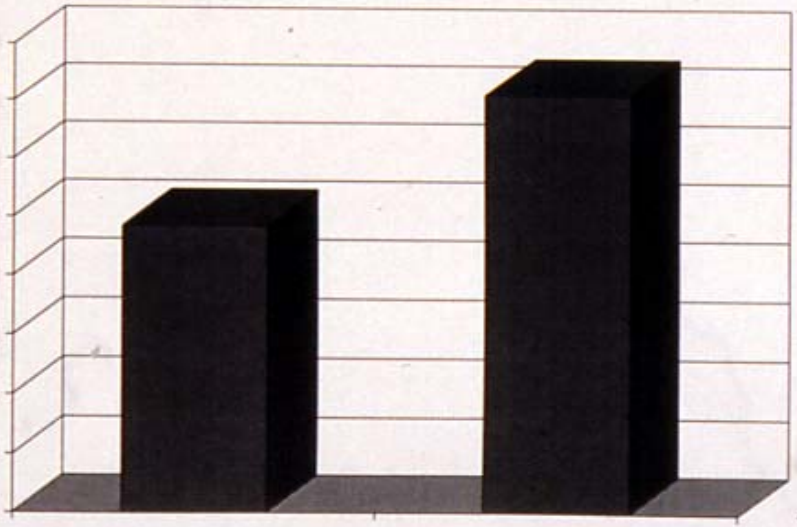
Cantidad de Establecimientos



Pérdidas de más de 60 mil establecimientos agrícolas

Aumento de la unidad económica promedio

Hectáreas



Fuente: Mora y Araujo Consultores, 2000.

Table Nº 3. Estimation of nutrients (N, P) exportation and the reposition cost for soybean harvest 2002/2003 (34.000.000 metric tons)

	Nitrogen	*Phosphorous*	*Total*
Nutrient Extraction in metric tons	1.020.000	227.800	**1.247.800**
Equivalent in Mineral Fertilizers in metric tons	2.217.400	1.109.386	3.326.786
Cost stimation reposition (US$)	576.524.000	332.816.000	909.340.000

Source: PENGUE 2003.

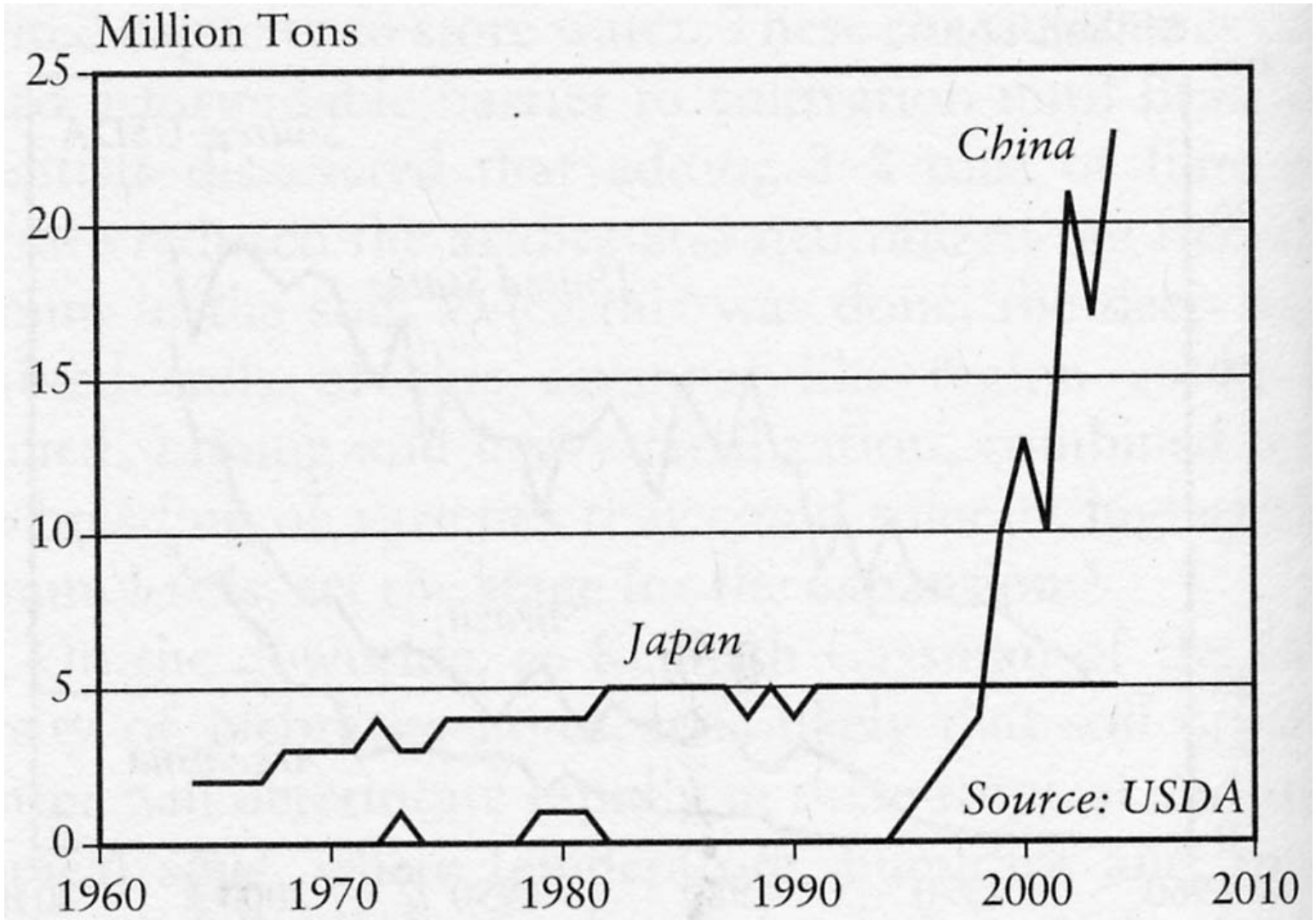
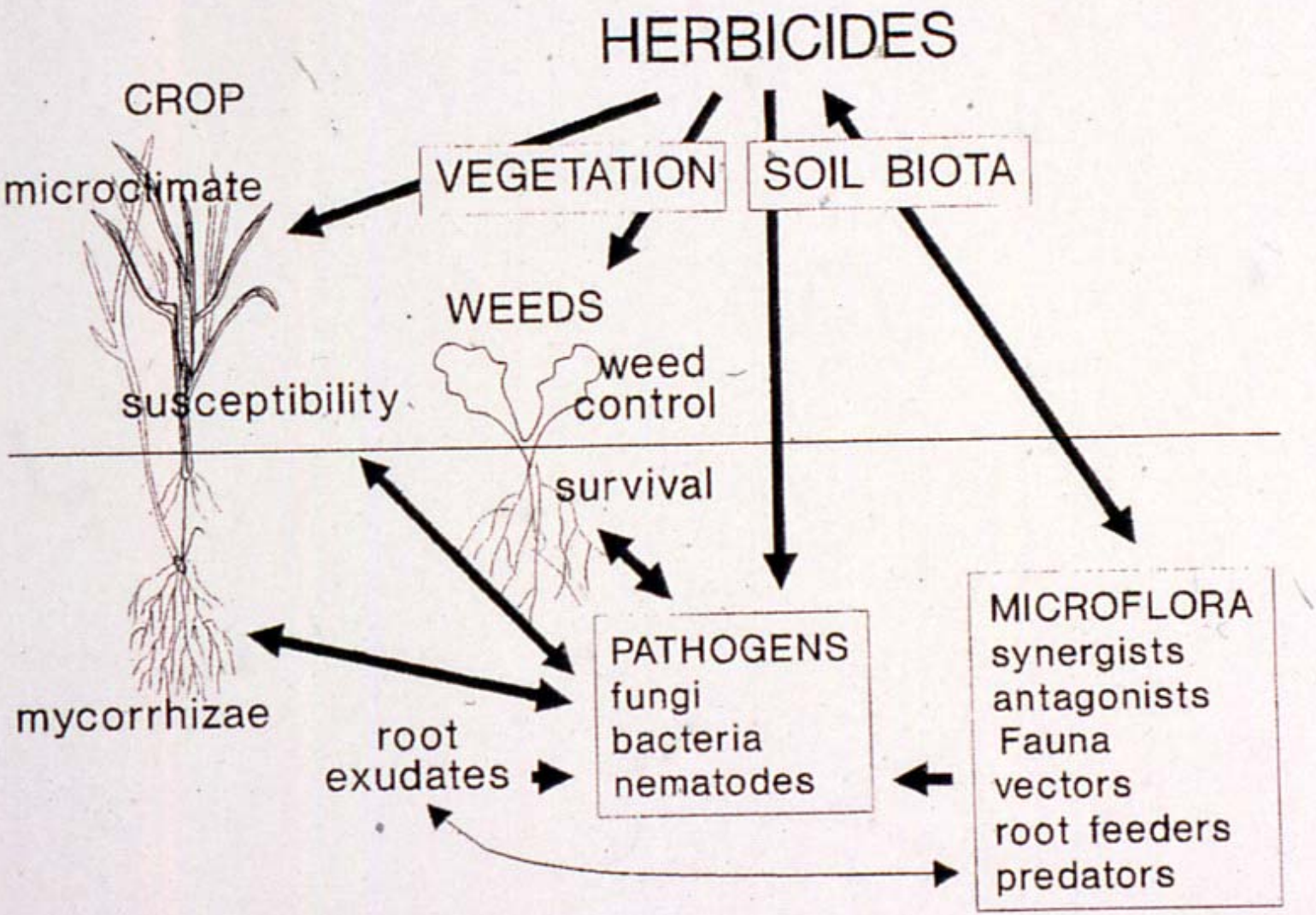


Figure 9–3. *Soybean Imports into China and Japan, 1964–2004*

Soybean and pesticide use

- In USA Roundup use increased from 6.3 million to 42 million pounds (1995-2000), 62% of the crop area sprayed with Roundup
- in Brazil 25% of all pesticides used in soybean- 50,000 metric tons in 2002- rate of increase 22% per year
- increased use of glyphosate > rates of herbicide resistance…shift to new and more toxic herbicides

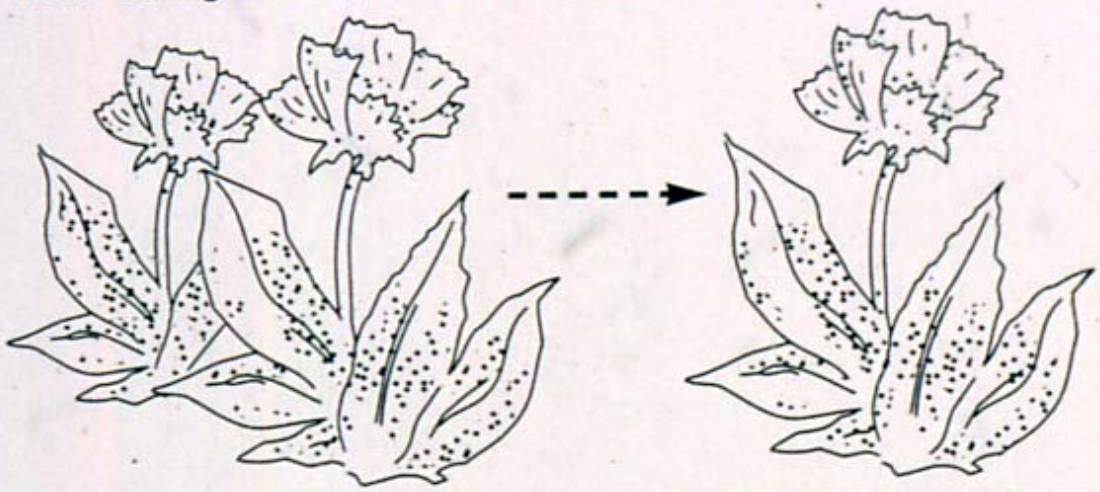
FIGURE 2. Potential interactions among herbicides, microorganisms, the crop and weeds



Effects of herbicide tolerant transgenic crops on soil organisms

- Rape: taxonomic diversity of root associated community altered, especially of *Rhizobium leguminosarum*
- Soybean: increased colonization of *Fusarium spp;* different *Pseudomonas sp* population detected
- In both crops community fatty acid and physiological profiles (CLPP) altered

1. The transgenic crops themselves become weeds.



2. The transgenic crops transfer pollen to wild relatives that become weeds.

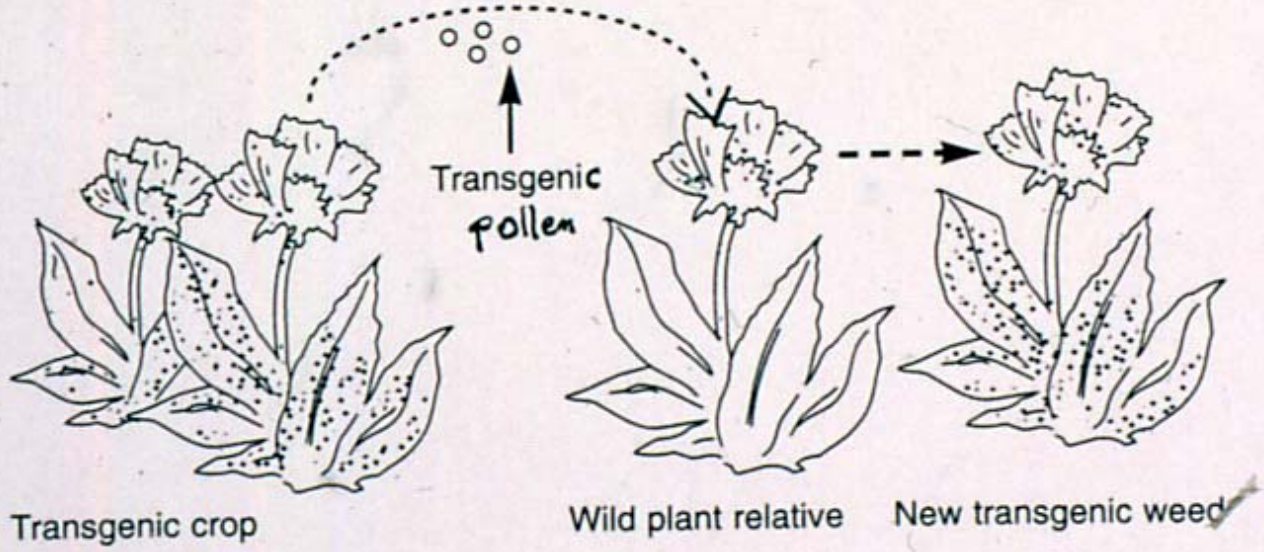


Figure 2.1
Risks of transgenic crops

Gene flow and transfer

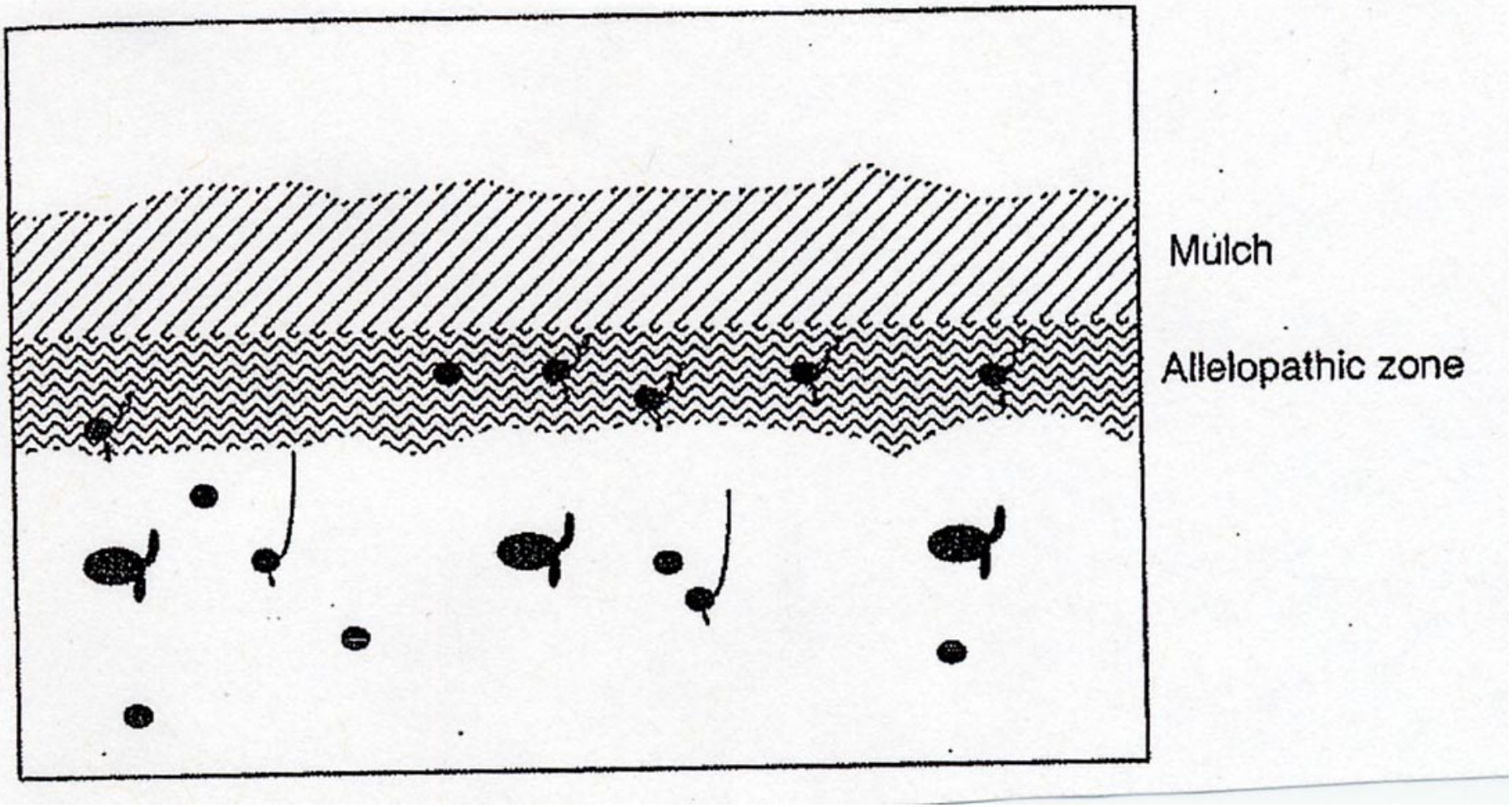
- Large scale cultivation of GMOs exacerbates gene flow enhancing fitness of sexually compatible wild relatives
- Several weeds have acquired resistance to glyphosate, imidazolinone and glufosinate
- within crop-gene flow: volunteer canola resistant to 3 herbicides from gene flow among 3 canola varieties designed to resist each herbicide

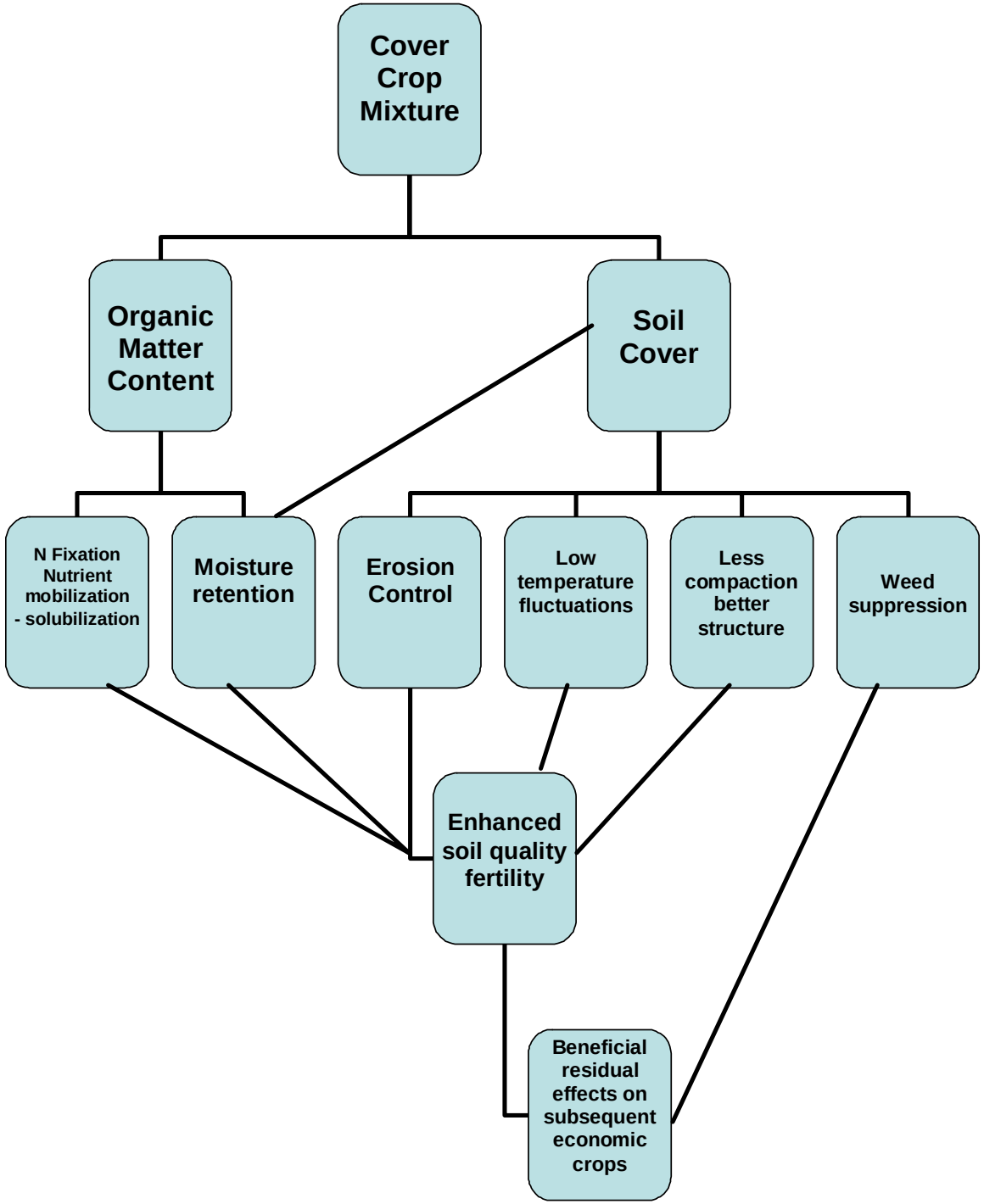
Soybean yields

- Average conventional soybean yields vary according to season and location reaching 2,300-2600 kgs/ha but in GE soybeans are 6% lower
- Under drought conditions GE soy exhibits 25% higher losses than conventional soy. Due to pleiotropic effects (splitting of stems) yields dropped 72 % in RGS (04/05 drought) and soy exports dropped 95%.
- Most farmers have defaulted on 1/3 of government loans

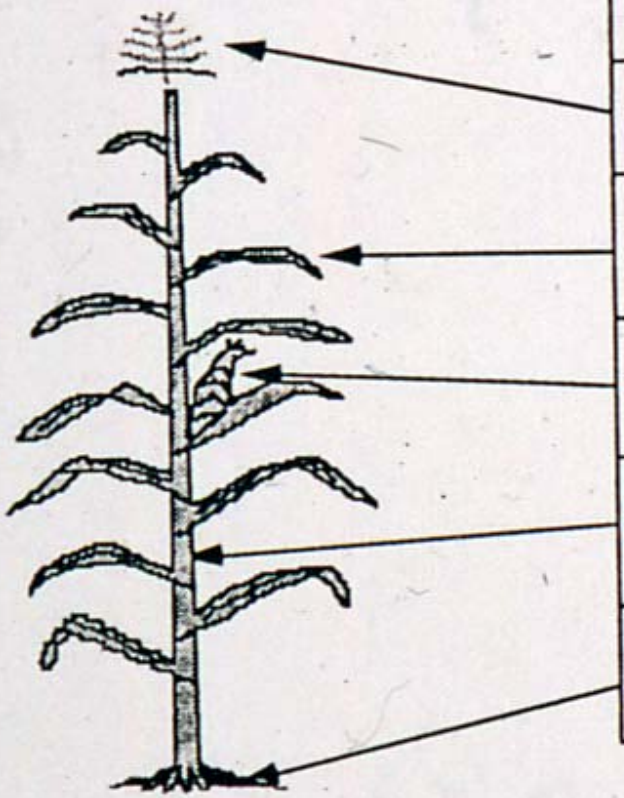
Factors influencing variable and lower RR soybean yields

- root development, nodulation and N fixation impaired; effects are worse under drought stress and infertile fields
- Levels of some regulatory proteins that affect timing and efficacy of plant defense mechanisms depressed after Roundup sprays
- monoculture and genetic uniformity: more diseases and cyst nematodes, > fungicides


Mülch
Allelopathic zone


Cover Crop Mixture
Organic Matter Content
Soil Cover
N Fixation Nutrient mobilization - solubilization
Moisture retention
Erosion Control
Low temperature fluctuations
Less compaction better structure
Weed suppression
Enhanced soil quality fertility
Beneficial residual effects on subsequent economic crops

NG CRYIA(b) PROTEIN/MG SOLUBLE PROTEIN IN VARIOUS PARTS OF PLANTS



	171 LINE	176 LINE
POLLEN/ ANTHER	0	339
LEAF	711	1496
KERNEL	212	16
PITH	3410	87
ROOT	2278	53

Fig. 3. Concentration of CryIA(b) protein in various parts of transgenic plants.

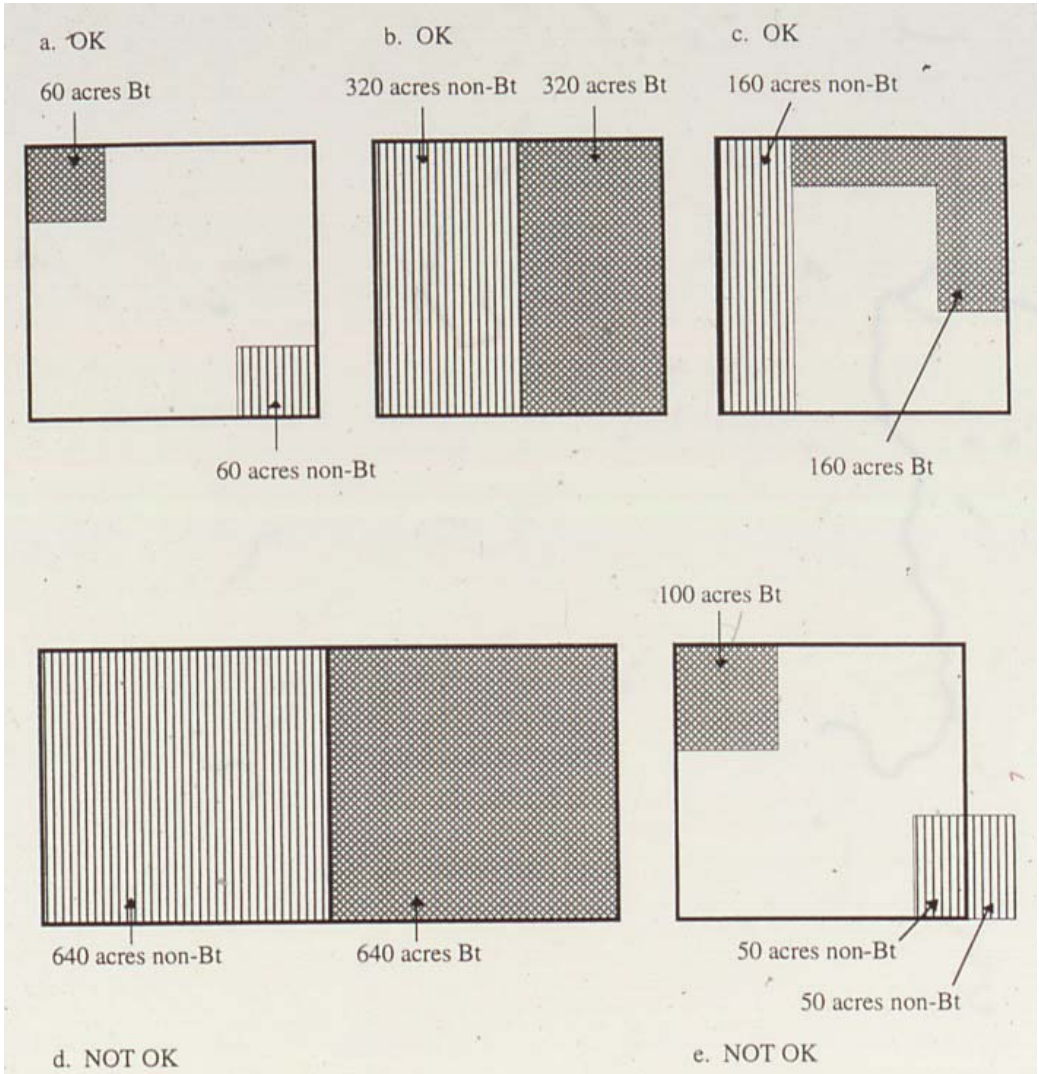


Figure 2. Examples of acceptable (a-c) and unacceptable (d-e) spatial arrangements of Bt and non-Bt cotton in areas where pink bollworm is absent, IPM option with 50% non-Bt cotton. Each bold square is 1 mile X 1 mile (=640 acres).

Figure 5. Insecticidal toxin created by *Bt* corn does not stay in the plant. This corn releases an insecticidal compound *(red)* through its roots into the soil. That compound can remain insecticidal for 230 days or more and could impact populations of soil organisms. In addition, pollen from *Bt* corn *(blue)* can travel as far as 60 meters, where it coats the surface of noncrop plants. Nontarget insects, including monarch butterfly larvae, consume some of the windblown corn pollen.

The real costs of genetic pollution

- Characteristics of genetically altered grain spread to local varieties undermining traits favored by small farmers (resistance to drought,etc) diluting the natural stability of these races
- Transgenic crops in centers of origin will accelerate the loss of indigenous varieties and associated knowledge that make systems sustainable.

Contamination of seed supply in the USA (Union of Concerned Scientists-2004)

- Pilot study of seeds of conventional varieties of corn , soybean and canola reveals that these seeds are pervasively contaminated with low levels of DNA sequences originating in transgenic varieties.
- DNA detected in 50% of the corn, 50% of the soybean and 100% of the canola tested.

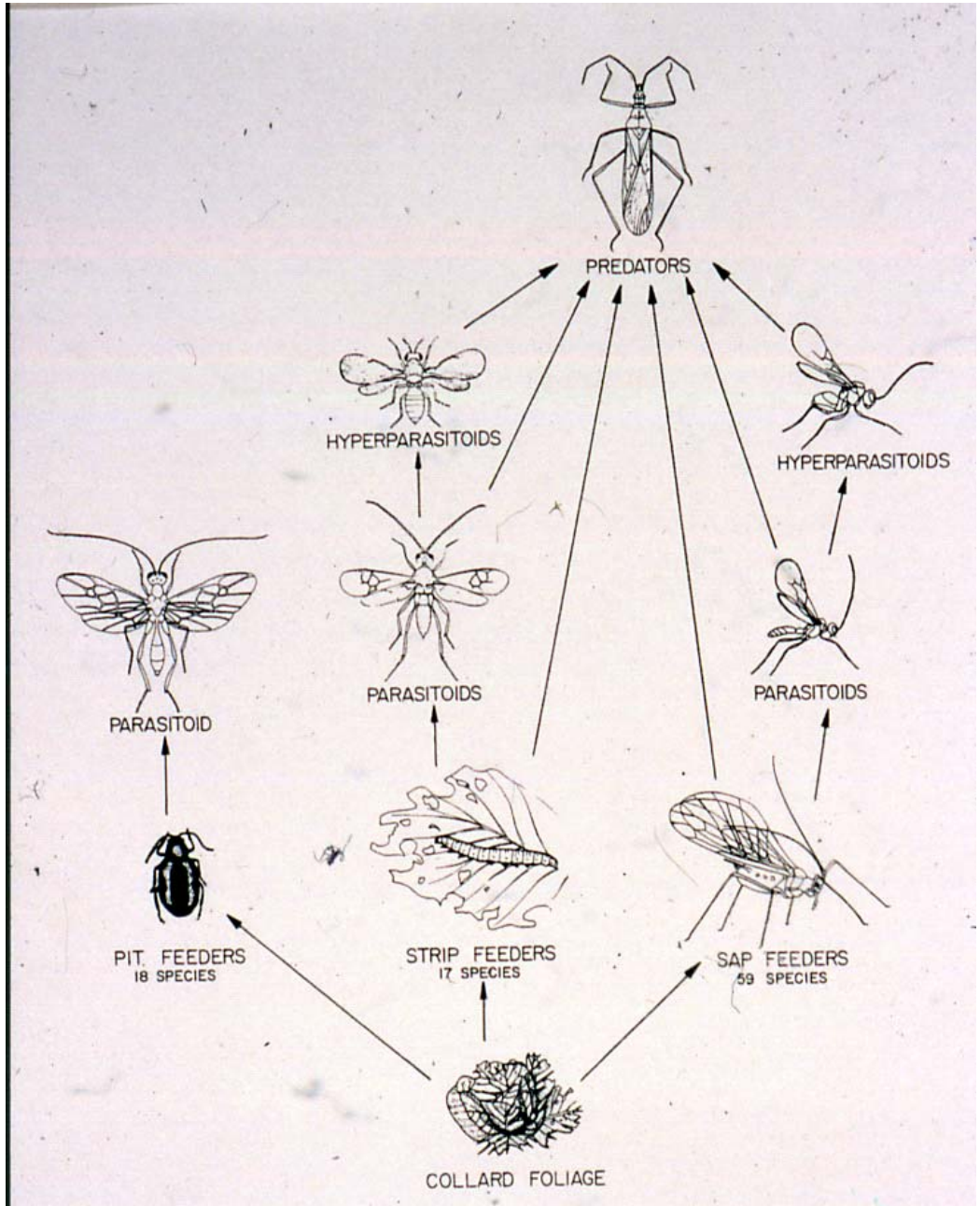
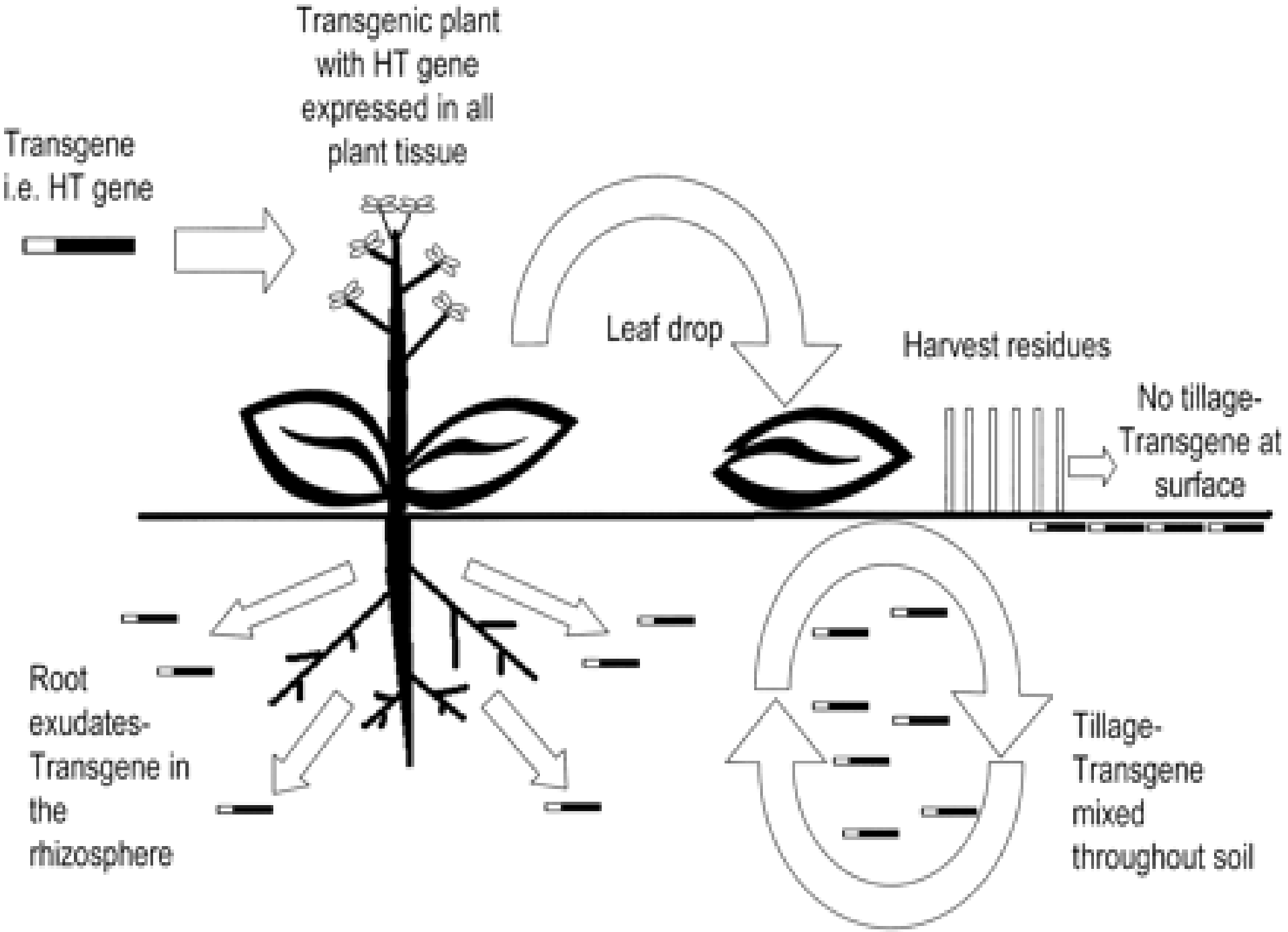


Fig. 1.1 Simplified food web based on collard plants showing three major guilds of herbivores, their parasitoids, hyperparasitoids, and predators. Pit feeders include flea beetles. Strip feeders are caterpillars. Sap feeders are sucking insects such as aphids. Based on Root (1973). Reprinted with permission from Price (1984b).

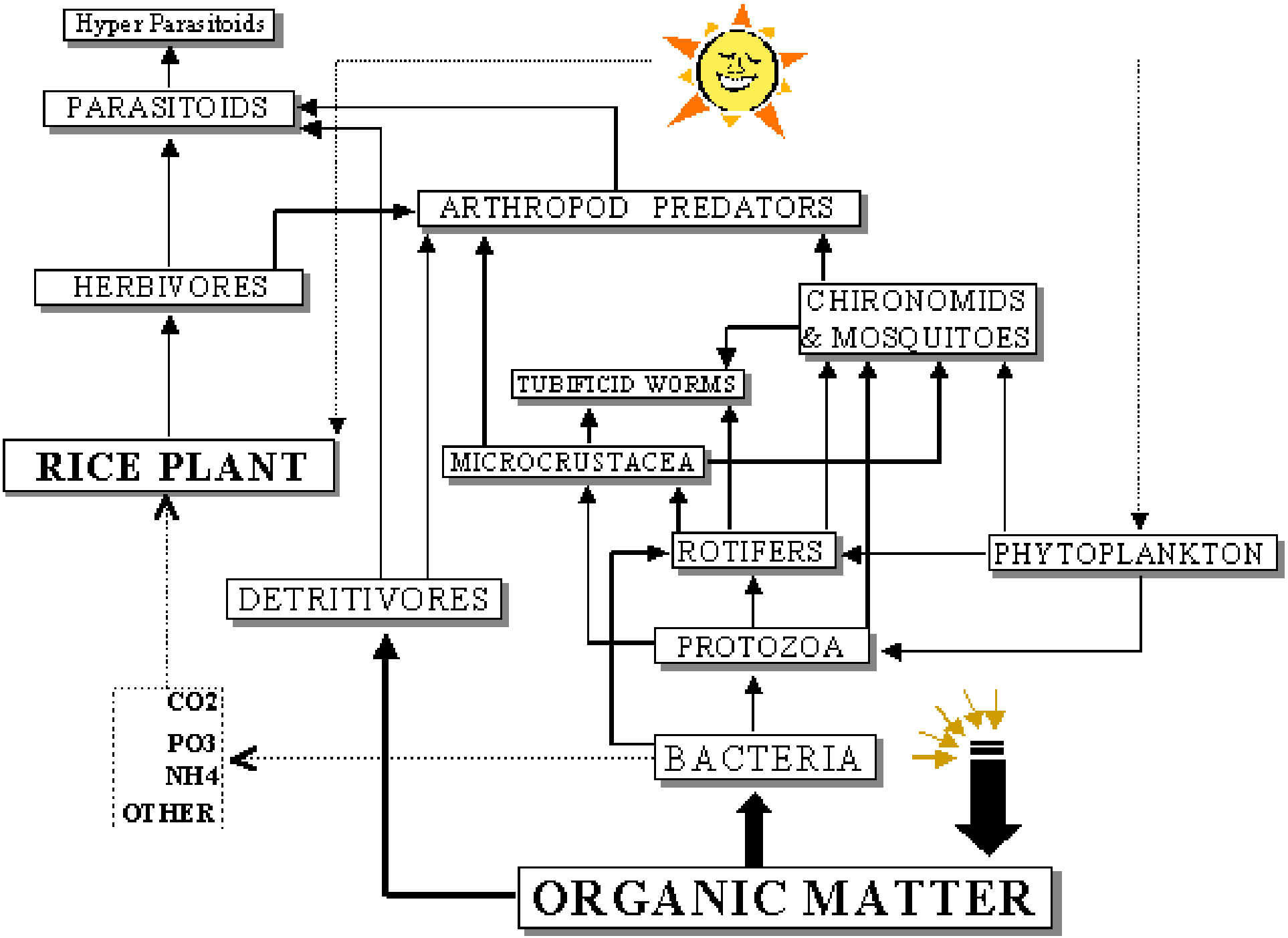

Transgenic plant with HT gene expressed in all plant tissue
Transgene i.e. HT gene
Leaf drop
Harvest residues
No tillage- Transgene at surface
Root exudates- Transgene in the rhizosphere
Tillage- Transgene mixed throughout soil

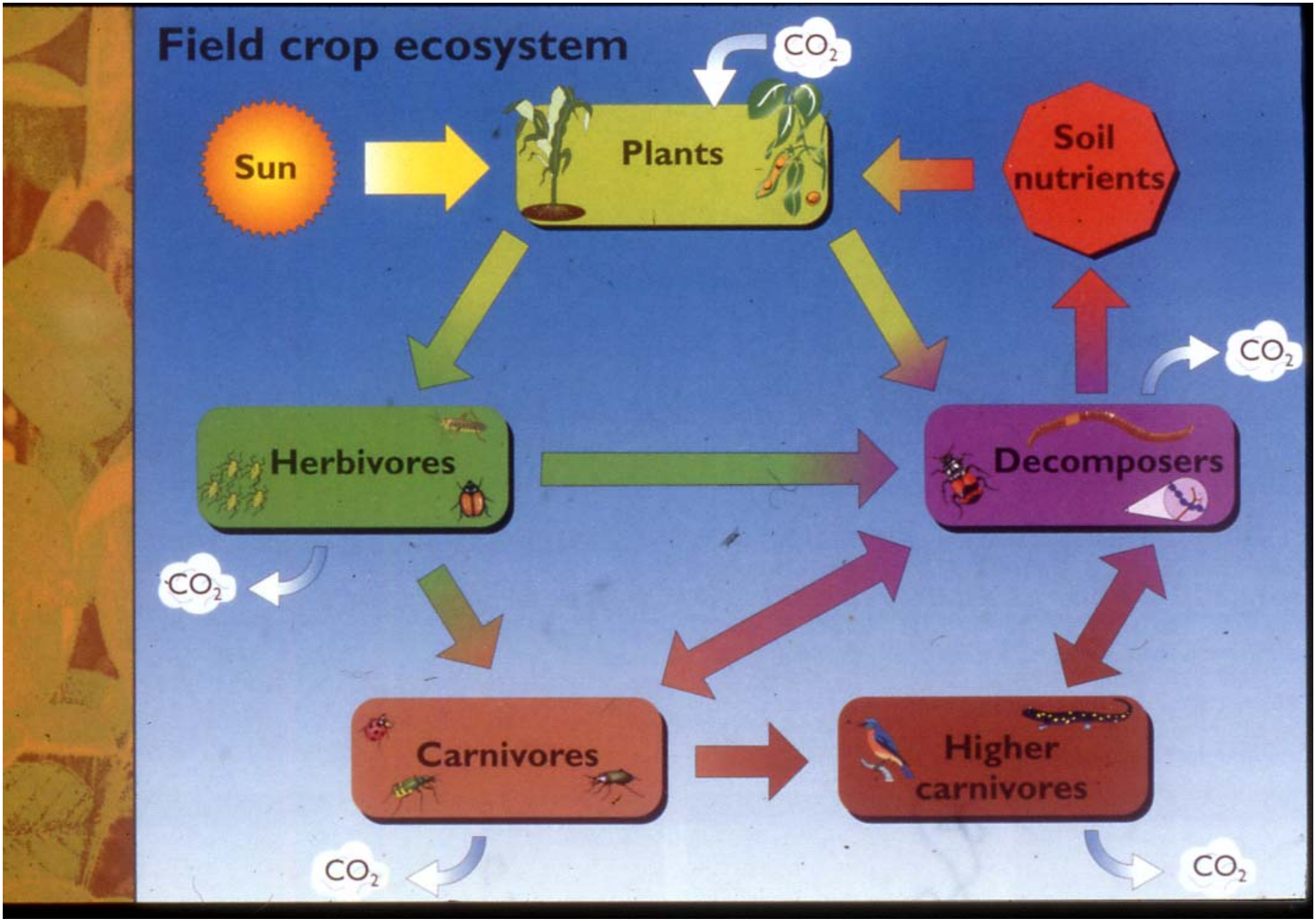
20 scientific assessments of transgenic plants on soil organims

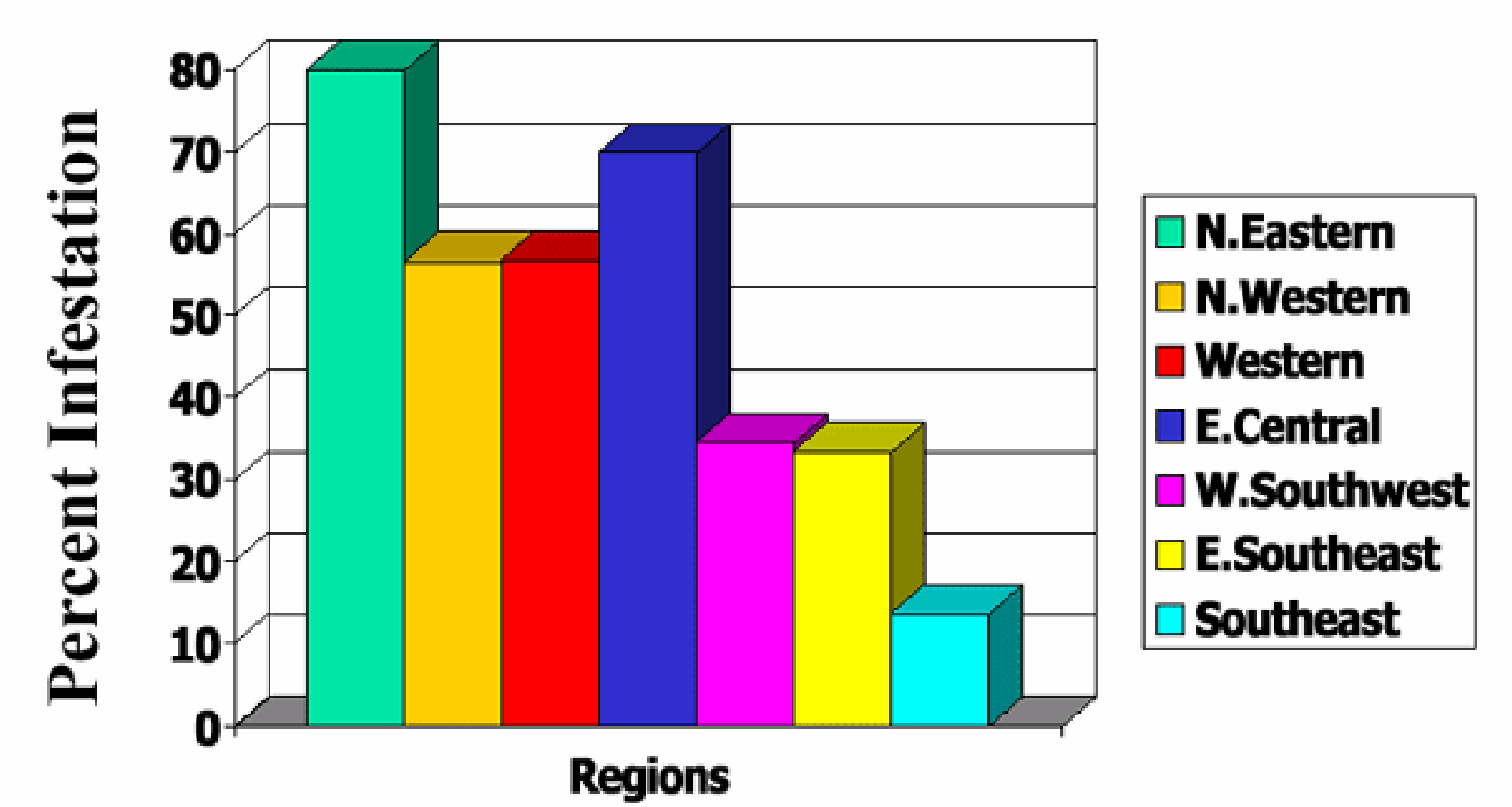
- Transgenic plants and litter can influence composition of plant associated microbial communities
- Effects include removal or appearance of specific functional groups of bacteria (plant growth promoting rhizobacteria, phytopathoengs and nutrient recyclers, thus affecting plant growth and health.
- Effects are dependent on location and season and some are variable and transient

Possible effects of transgenes in soil

- Transfer of transgenes to native soil microorganisms via horizontal gene transfer
- Novel proteins released by transgenic plants can influence soil microbial community stimulating growth of organisms that can use them
- Minor alterations in diversity of microbial community can affect soil health and ecosystem function and it turn plant growth
- More independent studies needed


Hyper Parasitoids
PARASITOIDS
ARTHROPOD PREDATORS
HERBIVORES
CHIRONOMIDS & MOSQUITOES
TUBIFICID WORMS
RICE PLANT
MICROCRUSTACEA
ROTIFERS
PHYTOPLANKTON
DETRITIVORES
PROTOZOA
CO2
PO3
NH4
OTHER
BACTERIA
ORGANIC MATTER


Field crop ecosystem
CO_2
Sun
Plants
Soil nutrients
CO_2
Herbivores
Decomposers
CO_2
Carnivores
Higher carnivores
CO_2
CO_2


Percent Infestation
80
70
60
50
40
30
20
10
0
Regions
N.Eastern
N.Western
Western
E.Central
W.Southwest
E.Southeast
Southeast

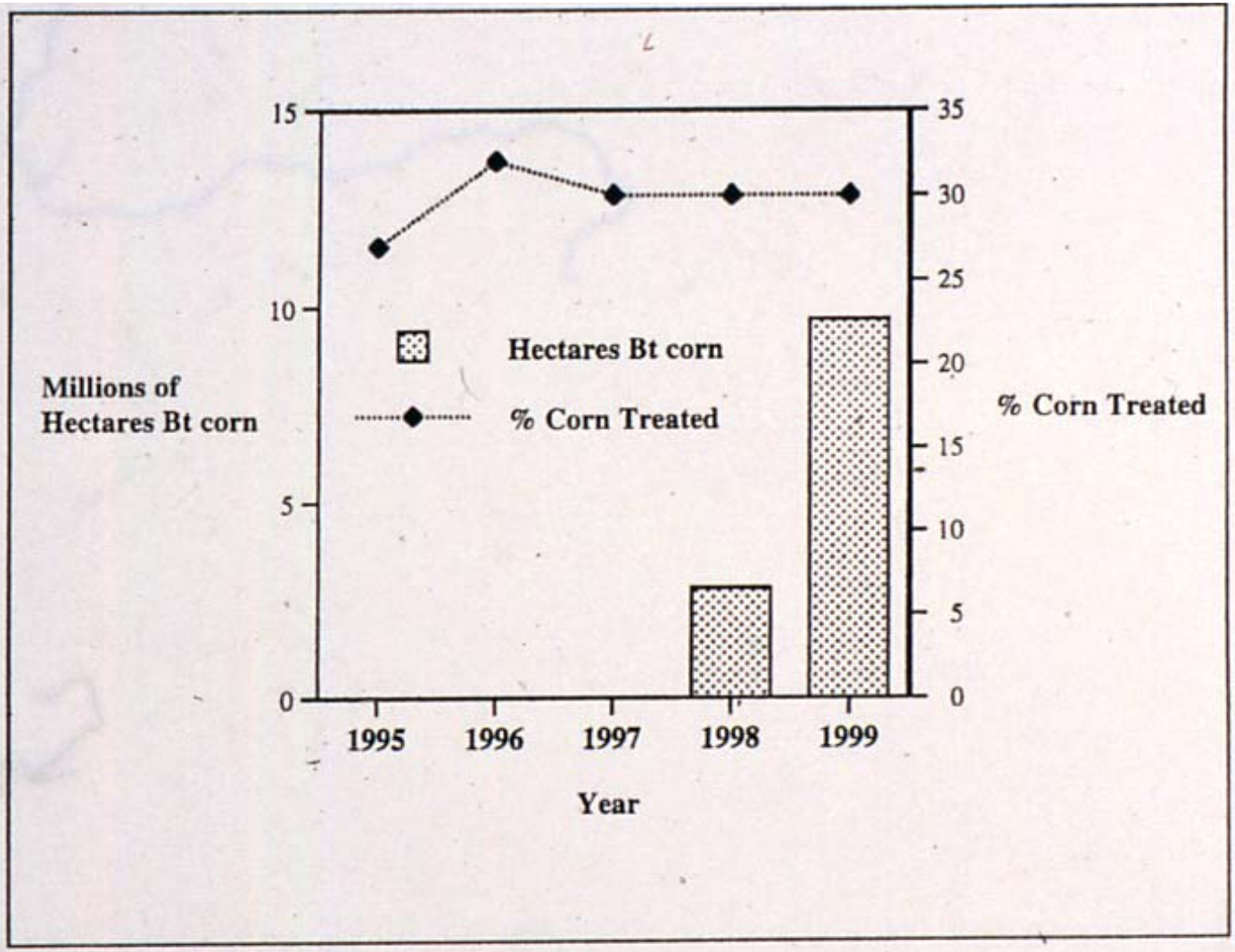


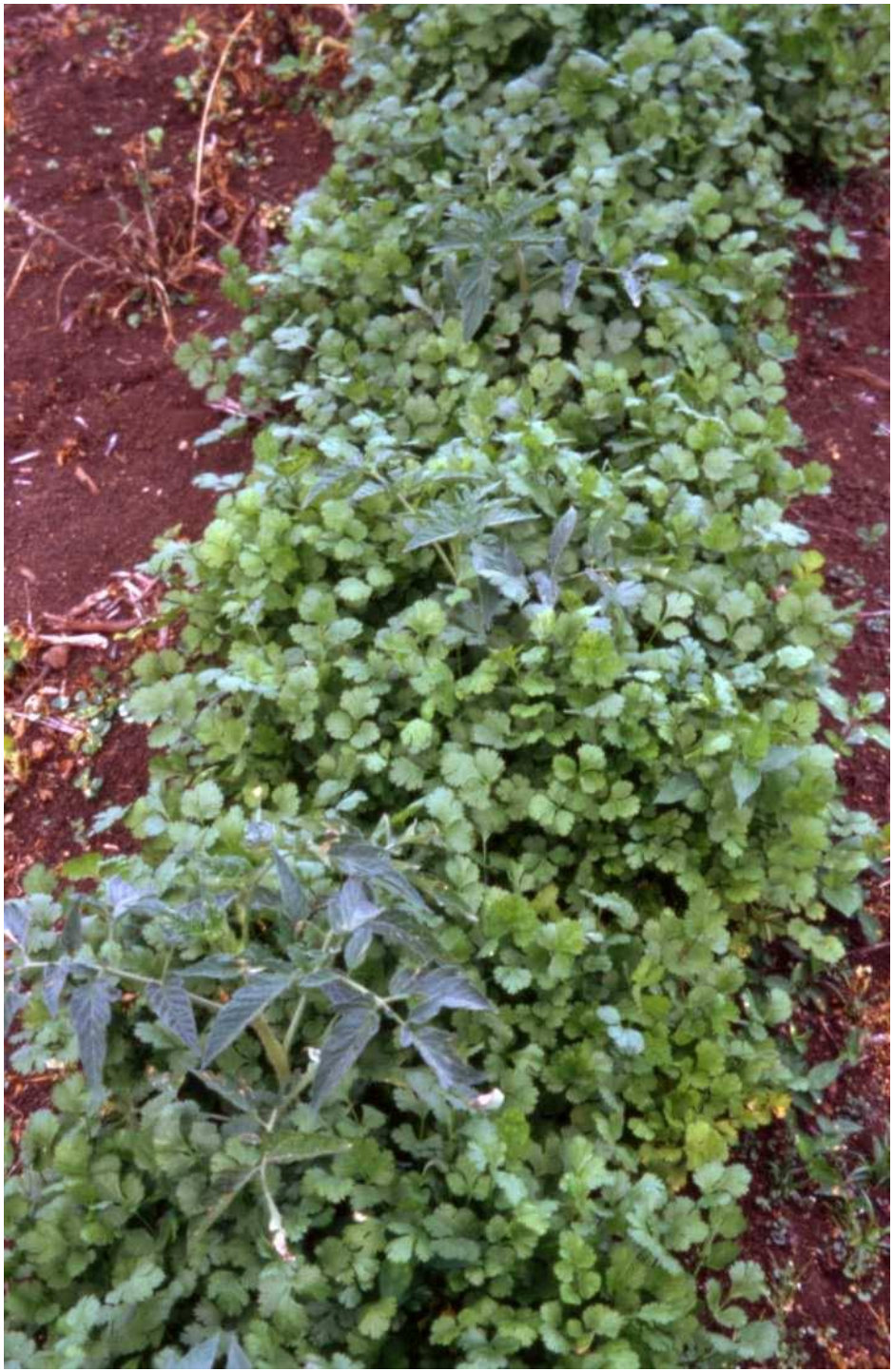
Figure 2. The percentage of field corn treated with insecticides and the number of hectares of transgenic Bt corn planted in the United States from 1995 to 1999. Insecticide data from USDA Agricultural Chemical Usage, National Agricultural Statistics Service for Field Corn. (1 May 2001;

Table 5. Gross income ($/ha) from best monoculture and best strip crop pattern from 1982 to 1985 in Champaign, Illinois (Wittler, 1982-1985).

Year	Crop	Monoculture Income	Strip Crop Pattern	Strip Crop Income	Difference (Strip-Mono)
		($/ha)		($/ha)	($/ha)
1982	Corn	913.82	4 × 4 Pioneer 3377	1128.22	
	Soybean	719.71	4 × 4 Pella	589.92	
	Average	816.76		859.07	+42.31
1983	Corn	466.14	8 × 8 Pioneer 3377	657.99	
	Soybean	482.12	8 × 8 Williams 82	613.16	
	Average	474.13	(E/W direction)	635.58	+161.45
1984	Corn	924.43	6 × 6 DeKalb-1100	1237.03	
	Soybean	684.17	6 × 6 BSR 201	644.65	
	Average	804.30	(E/W direction)	940.84	+136.54
1985	Corn	1115.39	4 × 4 GH H2604	1258.14	
	Soybean	800.40	4 × 4 Hobbitt	641.20	
	Average	957.90	(E/W direction)	949.67	−8.23
1982—1985, 4 year average					+83.02

Push-pull system for stem-borer control in African maize

- Napier and sudan grass as borders which act as trap crops and enhance parasitization by *Cotesia* wasps
- molasses grass and silverleaf (*Desmodium*) as intercrops that repel the stemborers
- *Desmodium* also suppresses *Striga*, fixes N, and is excellent forage increasing milk production. 15-20% maize yield increase, return of $2.30 for every $ invested.



Risks of transgenic crops

- Farmers are condemned to monocultures
- reduction of biodiversity and elimination of non target organisms
- Pests and weeds become resistant
- creation of super-weeds
- reduction of biodiversity and elimination of non target organisms
- BT toxins and roundup upset soil ecology

Cuestiones relacionadas con los riesgos de los transgenicos

- Muchos de los riesgos son reales
- La ciencia sobre riesgos es inconclusa
- Pocos estudios independientes y casi ningun ecologos ha participado en estudios
- Escasa financiacion publica y los pocos investigadores que han publicado han sido perseguidos
- Sector publico sin capacidad para generar y hacer que se cumplan normas bioseguridad

Principio de la precaucion

- Escepticismo de que la cincia puede entender y predecir biosistemas complejos
- Como manejar riesgos que son inciertos y de largo plazo en este estado de ignorancia
- Siempre hay posibilidad de error en la estimacion de impactos ambientales y sobre la salud

Normas de la aplicacion del principio de la precaucion

- Introductores de GMOs tienen responsabilidad de probar que no hay efectos
- Evitar error tipo II: error de asumir que no hay riesgo ambiental cuando el error existe
- Ausencia e evidencia de dano ambiental no es prueba suficiente

Implicancias para la investigacion publica

- Menor uso de pesticidas se usa como proxis de beneficios ambientaless
- Estudios solo comparan sistemas convencionales con GMOs , no se incluyen sistemas alternativos
- Se necesitan estudios de largo plazo con una decada de monitoreo
- Estudios mas alla de efectos sobre especies aisladas, incluir efectos sobre biodiversidad, procesos y funcion

Food must be produced where the poor live.

Requisitos de tecnologia apropiada para agricultores familiares

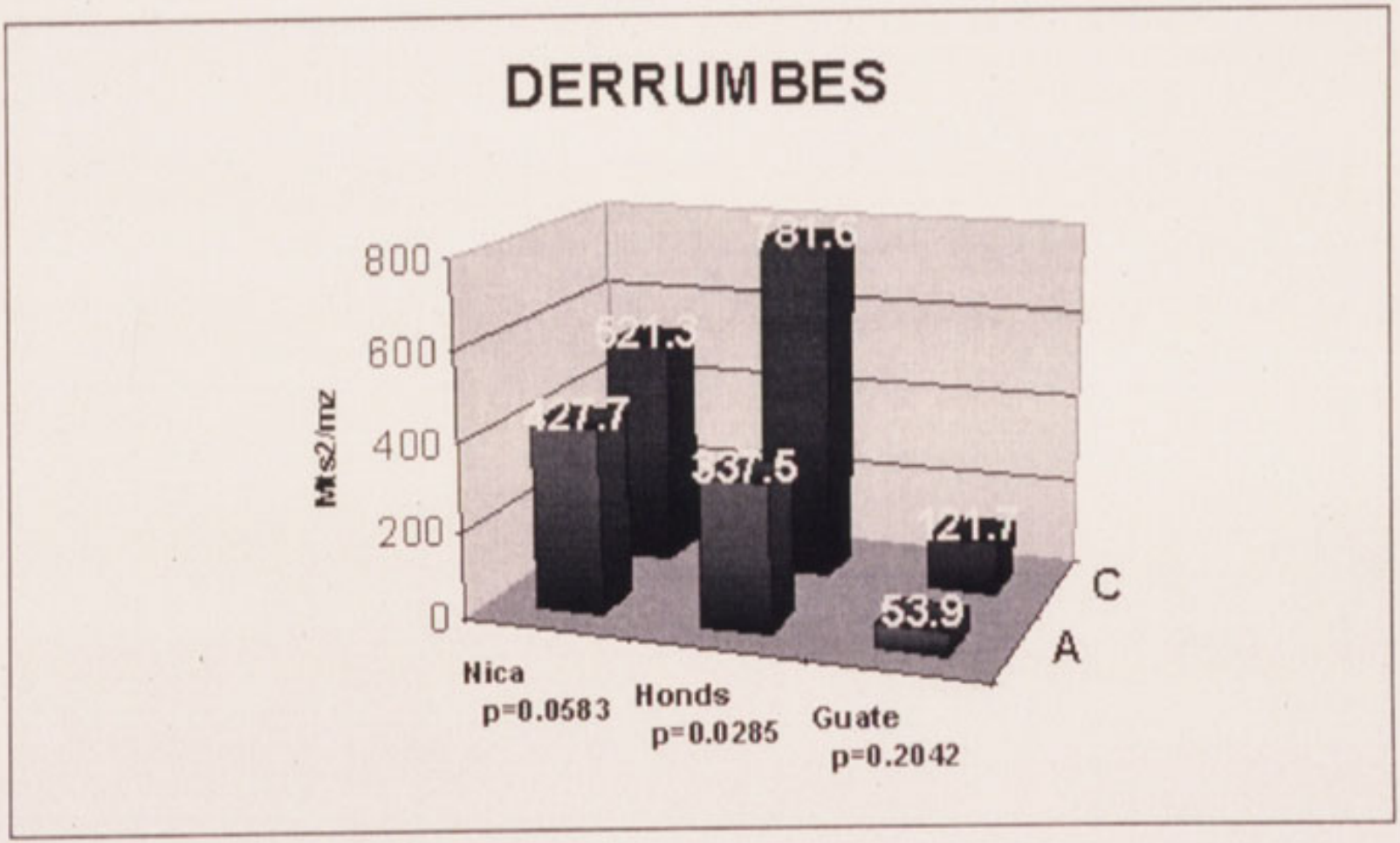
- Barata, accesible y basada en recursos locales. Limitan uso insumos externos.
- disminuyen riesgo y funcionan en ambientes fragiles/heterogeneos
- optimizan produccion total de la propiedad
- se basa en racionalidad y conocimiento tradicional
- es producto de proceso participativo

Velvetbean in Central America

- Mucuna fixes 150 Kg N/ha/year, produces 30-50 tonnes of biomass/ha/yr
- 45,000 familes growing Mucuna
- crop yields up from 400-600 Kg/ha to 2000-2500 kg/ha while conserving/regenerating soil in hillsides


11 16:43

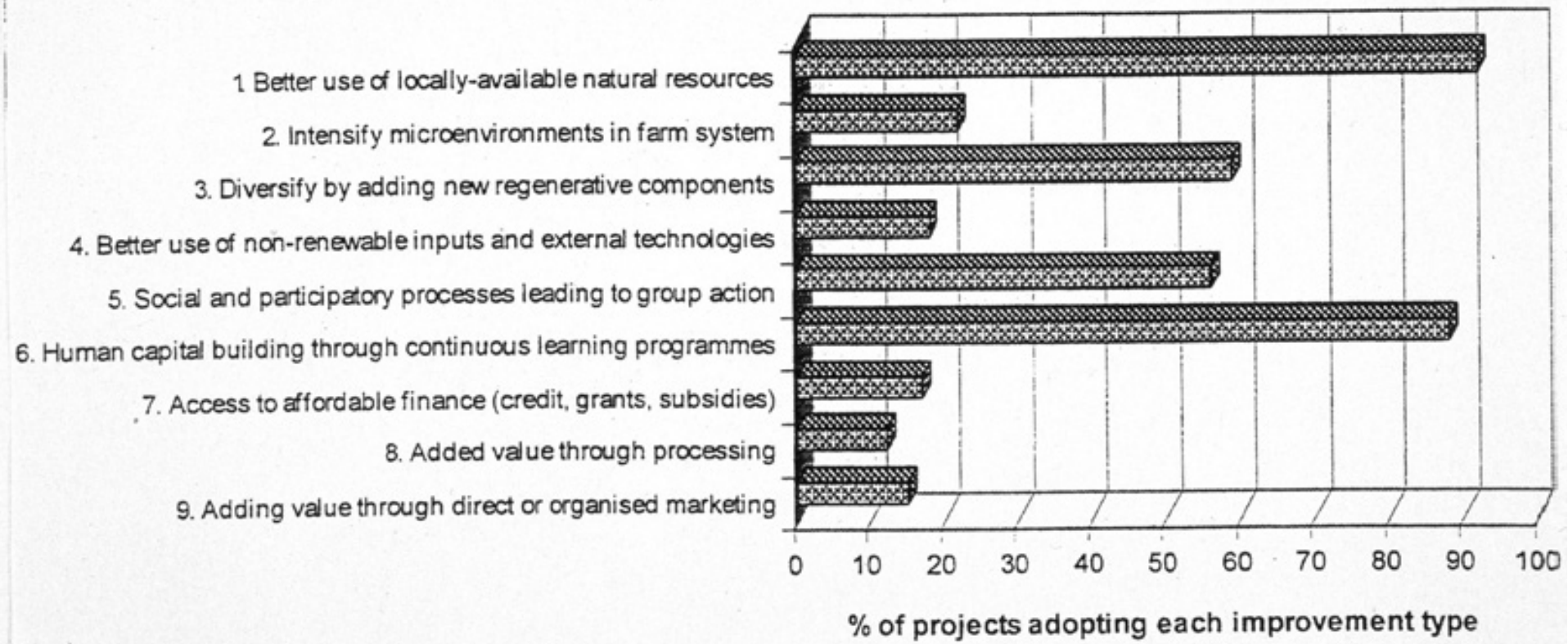
MUD SLIDES POST MITCH IN CONVENTIONAL (C) AND AGROECOLOGICAL (A) FARMS



Pretty's report

- 208 projectos/iniciativas
- 9 milliones de agricultores adoptan practicas sustentables
- 29 millones hectareas (3 % de la tierra arable en LDCs)
- Produccion por familia se incermento en promedio en 1,7 tons por ano
- 10% costo de proyectos convencionales Banco Mundial y CGIAR

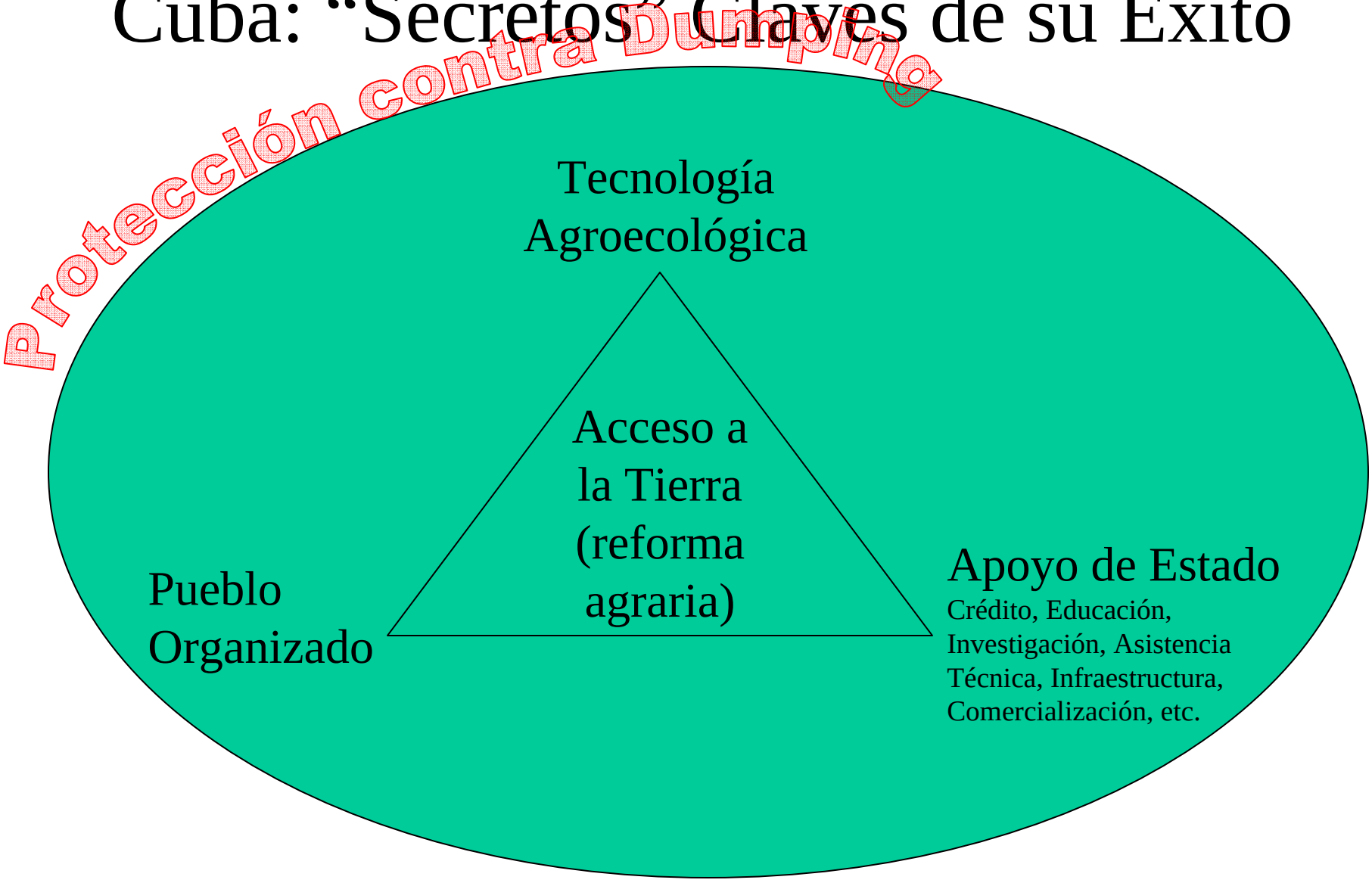
Figure 4. Proportion of projects adopting each sustainable agriculture type of improvment (n= 208 projects)




Cuba, con reforma agraria, sin dumping,
promueva la agricultura campesina ecológica

Huge Challenge to replicate the succesful elements of the Cuban case in other countries

Cuba: "Secretos" Claves de su Éxito



Propuesta alternativa de revitalizacion de la agricultura campesina

- Base de modelo de desarrollo economico-no como asistencia social
- Precos justos:proteccion de cultivos alimenticios
- Reforma agraria verdadera
- Tecnologias agroecologicas
- Promocion de ciclos locales produccion-consumo

Elementos de una nueva agricultura

- Produccion local (nexos directos agricultor-consumidor)
- Pequena escala, familiar
- Basada en la comunidadcommunity based
- Diversa biologica y culturalmente
- economicamente viable
- socialmente justa y participativa
- humana y compatible con la naturaleza

Requisitos de una agricultura sostenible

- Reforma agraria y cultivos fuera de OMC
- Precios justos a agricultores (no subsidios, no dumping), mercados locales
- Politicas agrarias conducentes
- Proteccion y re-enfoque de la investigacion publica
- Voluntad politica
- Solidaridad de los consumidores (comer es un acto ecologico-politico)
- Moratoria de transgenicos ocreacion de

Grandes problemas y desafios del siglo XXI

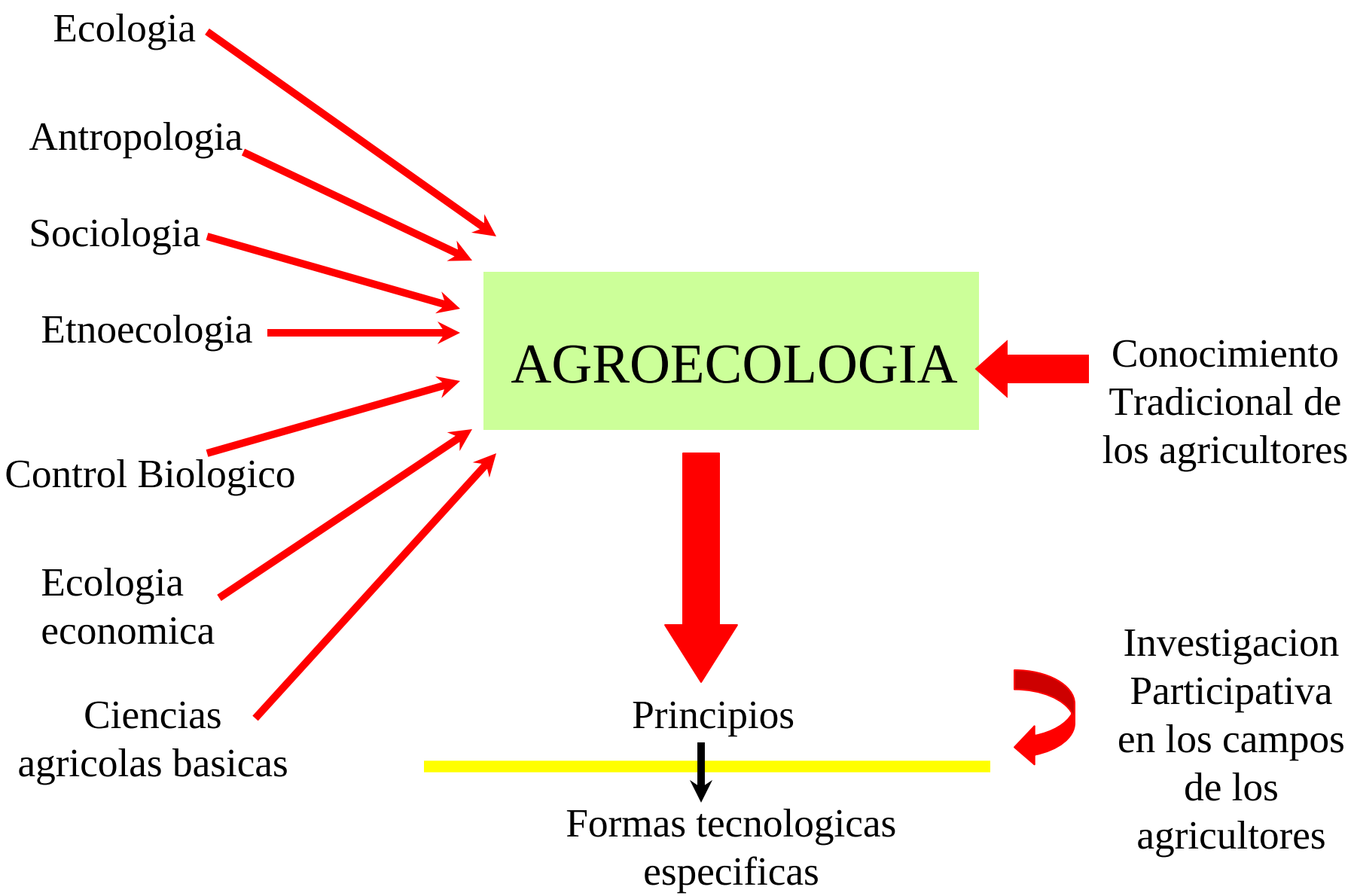
- Globalizacion y TLCs
- Biotecnologia y cultivos transgenicos
- Cambio climatico
- Agricultura para biocombustibles y captura de carbono
- Agricultura organica comercial de sustitucion de insumos
- Desplazamiento de la agricultura campesina e indigena

Objetivos de la agricultura sustentable de base agroecologica

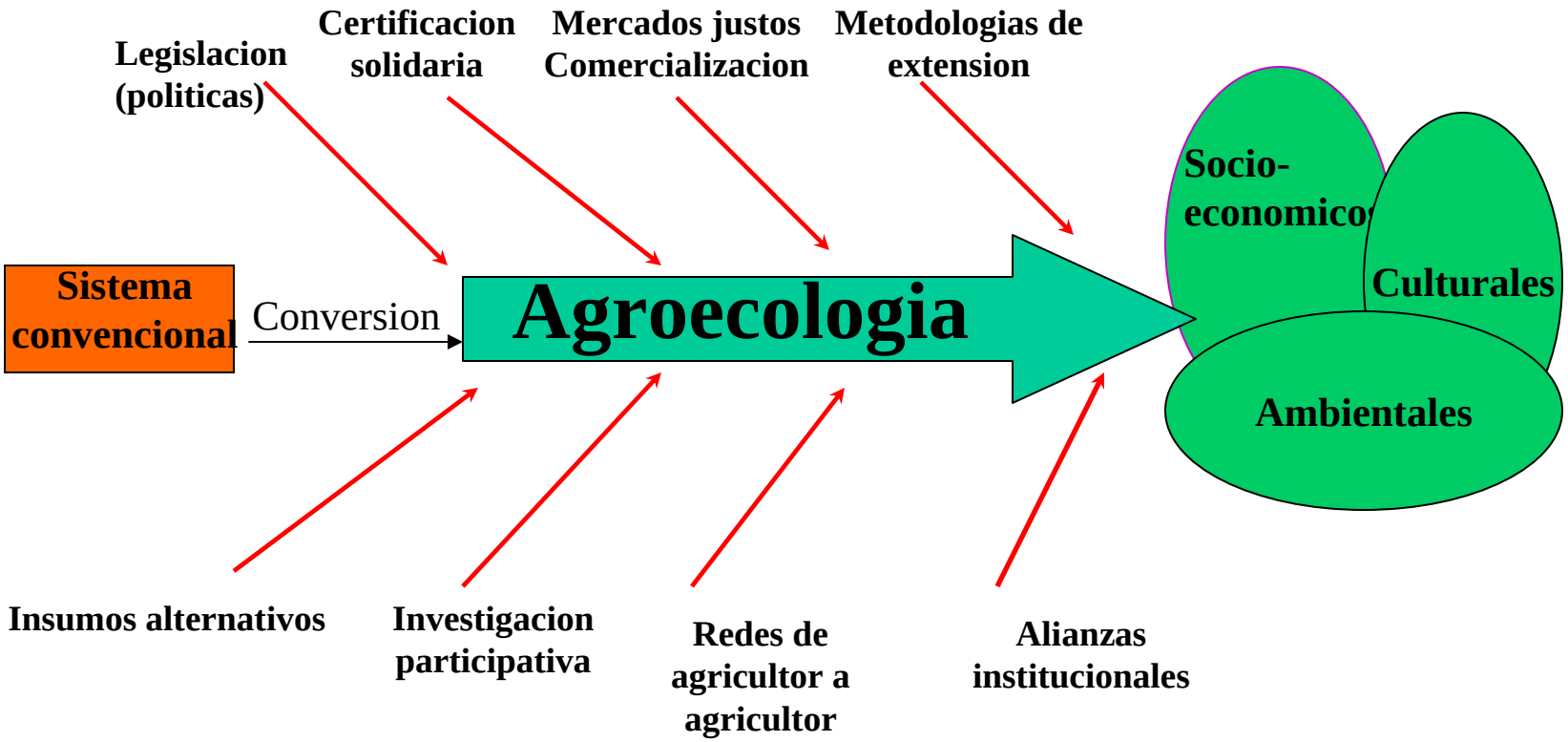
- Soberania alimentaria
- Rescate y conservacion de semillas criollas y nativas
- Regeneracion y conservacion de suelos y agua (a nivel de finca y microcuencas)
- Acceso a tierra productiva
- Empoderamiento de comunidades y organizacion social de la produccion
- Agricultura campesina/familiar como base del desarrollo economico

Grandes tareas de la agroecologia

- Recuperacion de sistemas tradicionales y mobilizacion del conocimiento indigena
- Regeneracion de cuencas y paisajes degradados
- Transicion mas alla de la sustitucion de insumos
- Investigacion para explicar sistemas agroecologicos exitosos y medir sustentabilidad
- Escalonamiento de propuestas agroecologicas locales y exitosas


Ecologia
Antropologia
Sociologia
Etnoecologia
Control Biologico
Ecologia economica
Ciencias agricolas basicas
AGROECOLOGIA
Conocimiento Tradicional de los agricultores
Principios
Formas tecnologicas especificas
Investigacion Participativa en los campos de los agricultores

Agroecologia y Desarrollo Sustentable




Ocupacion


Acampamento


Educacion


Asentamento


Produccion

Organización para la gestión social de los recursos naturales


ENCONTRO NACIONAL DE
FORMAÇÃO CAMPONESA

Septiembre 2002

- 3,000 asentamientos => 350,000 familias asentadas
- 8,000,000 hectáreas (cifras aproximadas)
- 459 campamentos => 61,000 familias


SEMENTES
1,00 CADA
BioNatur


Derecho de imagen
Ceam


BANCA AGROECOLOGICA
JOSE INNOCENTE NETO
EFAPI
23


PRODUTOS COPAC
Geleia de Pêssego


PEPINO
PEPINO
PEPINO

PROJETO AGROINDÚSTRIAS (PRONAF)

- Pequeno porte,
- Associativas,
- Localizadas no espaço rural,
- Articuladas em rede.






Sítio Novo Horizonte
ASSOCIAÇÃO DE AGRICULTORES
ECOLÓGICOS DE ITUPORANGA
PRODUTOR: AFONSO KLÓPPEL


Bem Vindo a
Santa Rosa de Lima
Aqui se produz alimentos
livres de Agrotóxicos

Carriles del Desarrollo