Five years of "*adaptative*" research for upland DMC based cropping systems creation in Cambodia

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Plan

1st PART

Rapid highlights on climate and soils conditions and reference plow based cropping systems

2nd PART

Progressive design of diversified DMC based cropping systems

3rd PART

Future Evolutions in the next coming years

1st PART

Rapid highlights on climate and soils conditions and reference plow based cropping systems

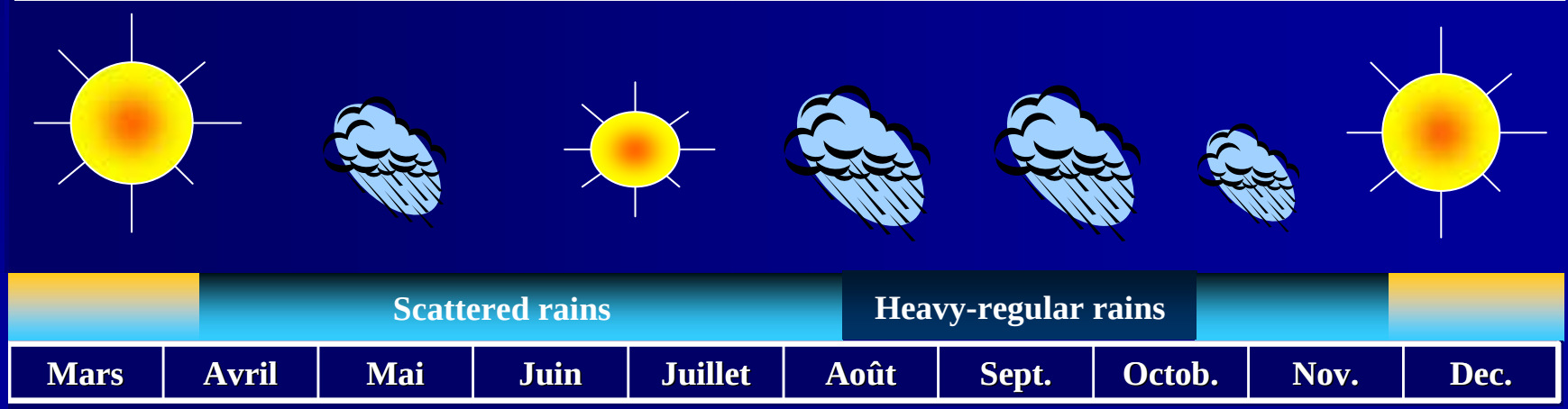
1/ Rapid Highlights on climate and soil's conditions …

1.1/ Main characteristic of the Cambodian central plain's climate

Climate of the Central plain

- **Hot** (average T° = 28°C) and **sunny** (> 2 400 hours)
- **6-7 months rainy season** (from ± 4/15 to ± 11/1)
  5-6 months dry season
- **abundant rainfalls** (1200-1600 mm/year)

But 3 climatic hazards randomizes the rain repartition (irregularity and variable)



1.2/ Main location of Upland cultivation on Red and Black basaltic soils

1/ Rapid Highlights on climate and soil's conditions …

1.3/ Key features of red basaltic oxysol ("ferralitique")

		Soil 1				Soil 2			
Depth	***cm***	***0-10***	***10-20***	***20-40***	***40-60***	***0-10***	***10-20***	***20-40***	***40-60***
% Sand		5,8	4,7	3,9	4,1	7,9	7,3	6,0	5,5
% Silt		13,8	13,5	12,9	12,9	12,7	14,1	13,6	12,1
% Clay		80,5	81,8	83,3	83,3	79,4	78,6	80,4	82,4
C organic	**g/dm³**	26,4	20,9	16,8	13,9	16,3	14,7	11,8	8,2
Organic matter	**%**	5,0	4,0	3,2	2,7	3,1	2,8	2,3	1,6
pH CaCl2		4,7	4,5	4,4	4,5	4,3	4,3	4,4	4,4
H + Al	**cmolc/dm³**	7,11	7,36	6,95	6,59	9,12	9,32	8,34	7,88
Al exchangeable	**cmolc/dm³**	0,41	0,60	0,73	0,64	1,67	1,66	1,42	1,42
Ca exchangeable	**cmolc/dm³**	2,63	1,83	1,70	1,43	1,67	1,59	1,71	1,68
Mg exchangeable	**cmolc/dm³**	1,13	0,90	0,61	0,85	1,40	1,32	1,19	0,97
K exchangeable	**cmolc/dm³**	0,35	0,26	0,15	0,16	0,08	0,05	0,03	0,03
P exch.	**mg/dm³**	7,2	5,4	4,4	6,5	27,3	26,8	31,7	37,5
CTC at pH 7,0	**cmolc/dm³**	11,2	10,3	9,4	9,0	10,6	11,1	10,9	9,3
CTC effective	**cmolc/dm³**	4,5	3,6	3,2	3,1	4,8	4,6	4,4	4,1
Sat. for bases (V)	**%**	36,5	28,8	25,3	25,5	53,3	43,1	27,2	54,3
Sat. for Al (m)	**%**	9,6	17,3	25,5	25,2	34,9	36,3	32,8	34,9
Sat. for Ca	**%**	23,3	17,7	17,2	14,8	31,7	22,2	15,8	36,6
Sat. for Mg	**%**	10,1	8,7	6,5	9,1	20,4	20,0	11,1	16,9
Sat. for K	**%**	3,1	2,5	1,6	1,6	1,2	0,8	0,3	0,8

Very high	**High**	**Medium**	**Low**	**Very low**

80% CLAY

Medium to high C contain

Low to very low pH
Low saturation rate by bases
High degre of saturation by Al

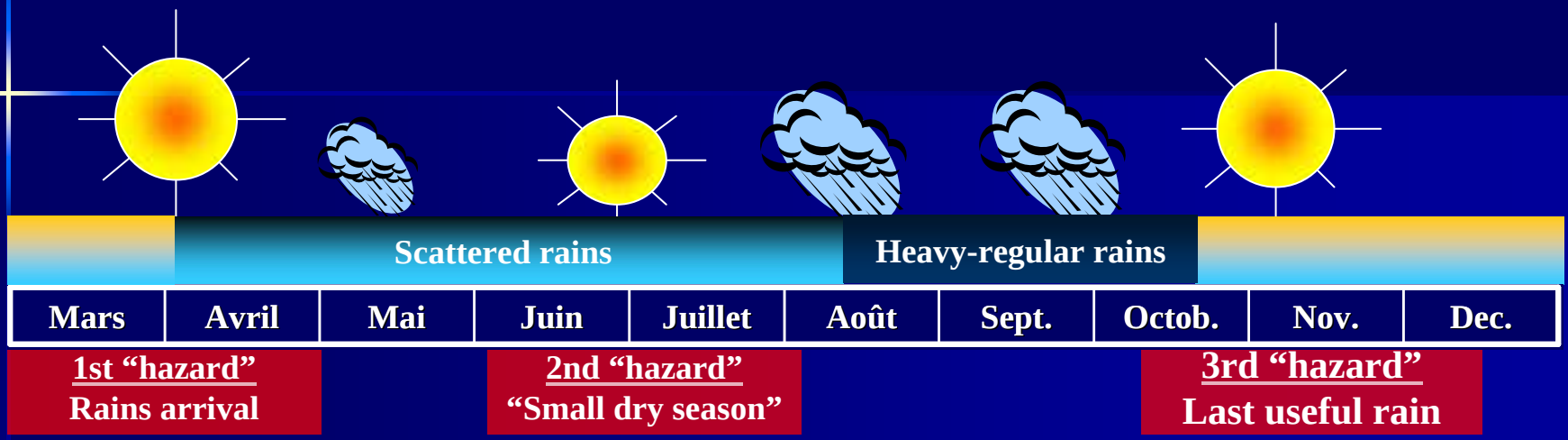
Low Ca contain
Medium to high Mg contain
V. low to v. high K contain

Low to high Pexch contain

Unbalanced saturation by bases : pronounced relative deficiencies in K and Ca compared to Mg

1/ Rapid Highlights on …reference plow based systems

1.3/ Main Plow based cropping systems on Kampong Cham's upland



1/ disc **Sesame** disc **Soybean**

2/ disc **Cassava Monoculture**

High technical and economical randomization + soil's degradation

→ irregular and decreasing profit margins

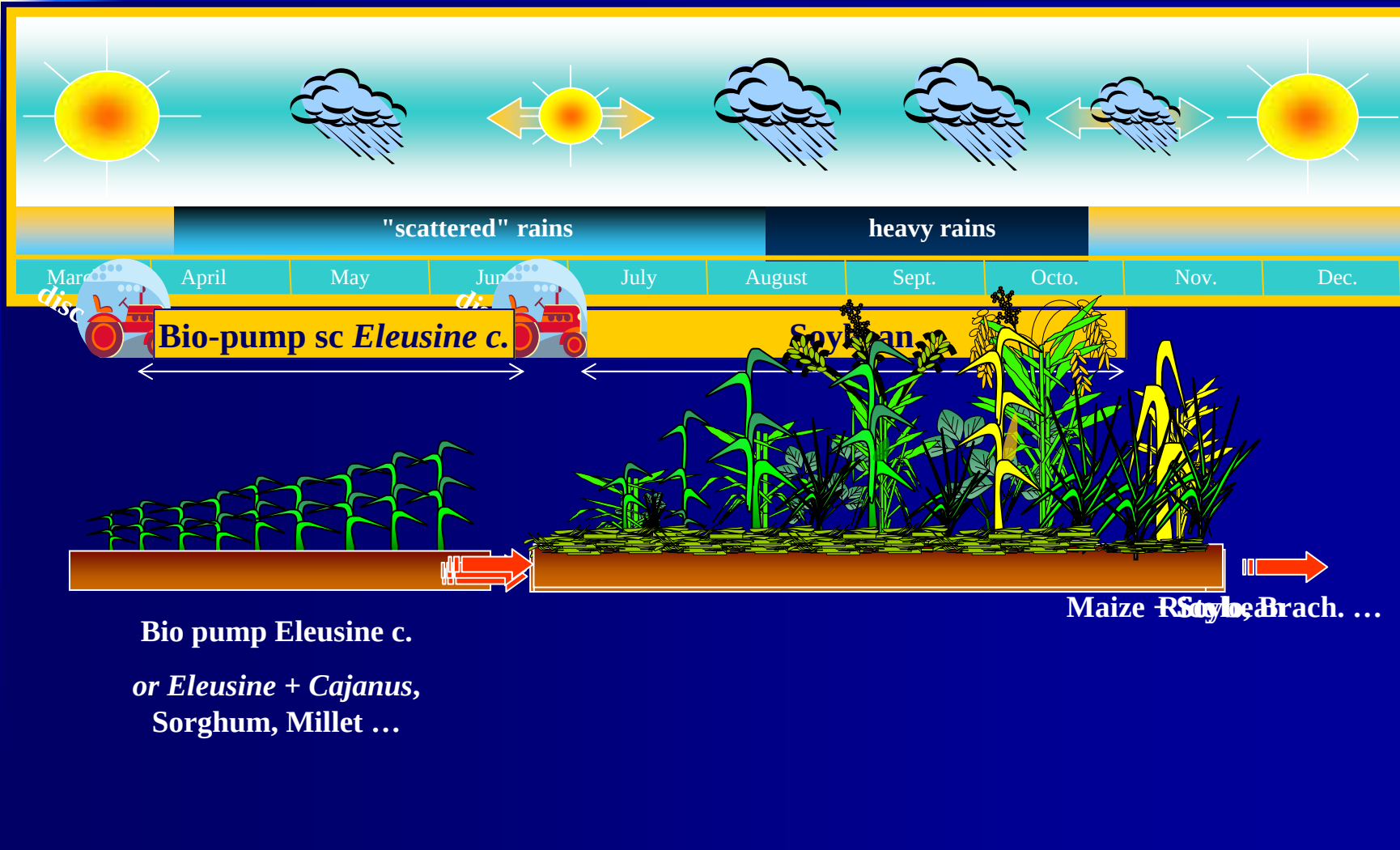
→ progressive shifting to perennial

2nd PART

Progressive design of diversified DMC based cropping systems

2/ Progressive design of diversified DMC based systems

2.1/ First DMC based, using short term biomass production



Bio pump Eleusine c.

or Eleusine + Cajanus,
Sorghum, Millet …

2/ Progressive design of diversified DMC based systems

2.1/ First DMC based, using short term biomass production (Photos)

The "bio pumps"

The main crops

Eleusine coracana

Mulch of Eleusi + Cajanus

Sorgho pool preto at 65 DAS

Soja on Eleusine

Maize on Eleusine

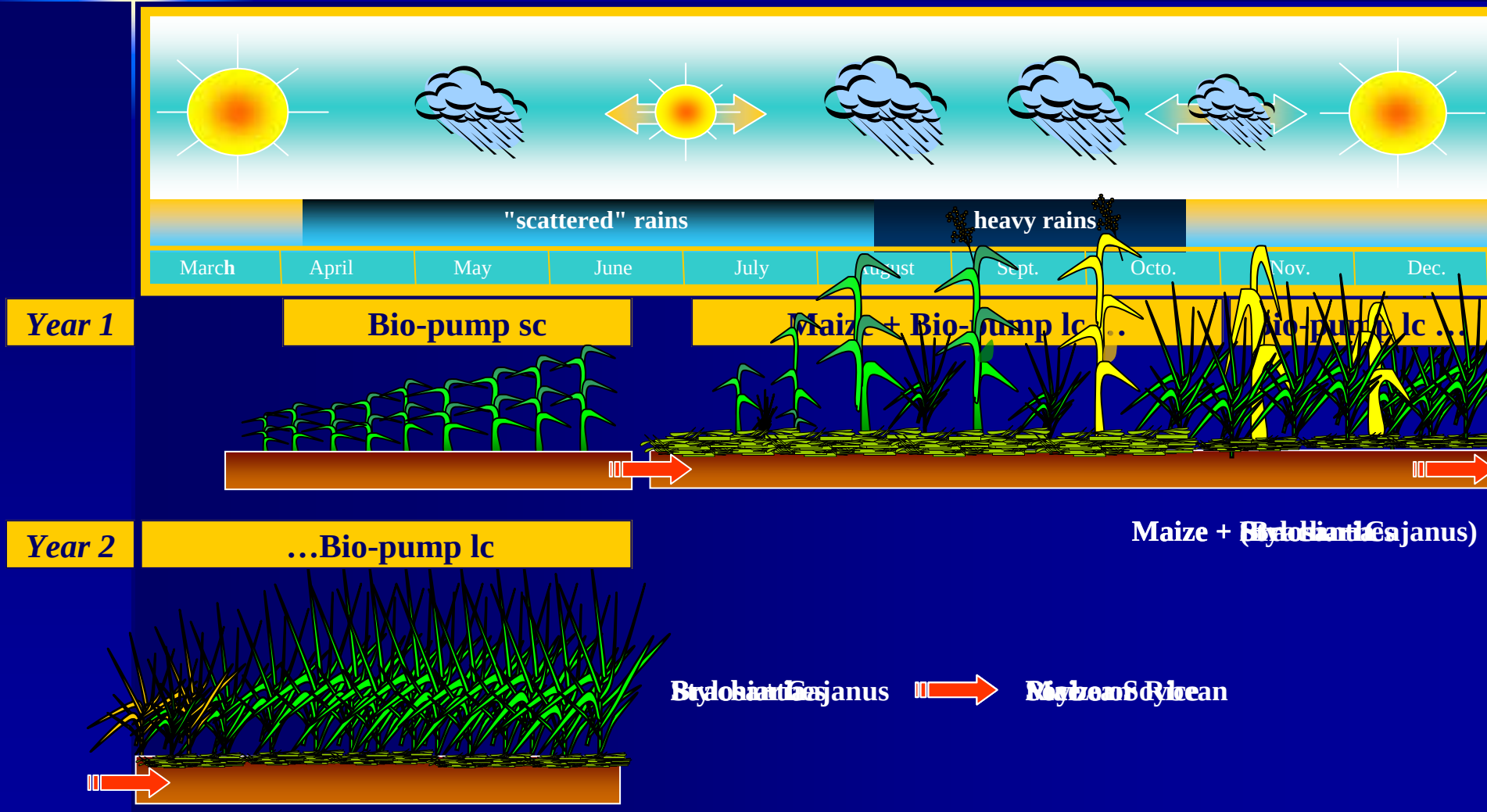
Riz on Eleusine

Coton on Eleusine

2/ Progressive design of diversified DMC based systems

2.2/ The “second” generation, using long term biomass production

Step 1: association of Bio-pump lc with Maize



2/ Progressive design of diversified DMC based systems

2.2/ The “second” generation, using long term biomass production

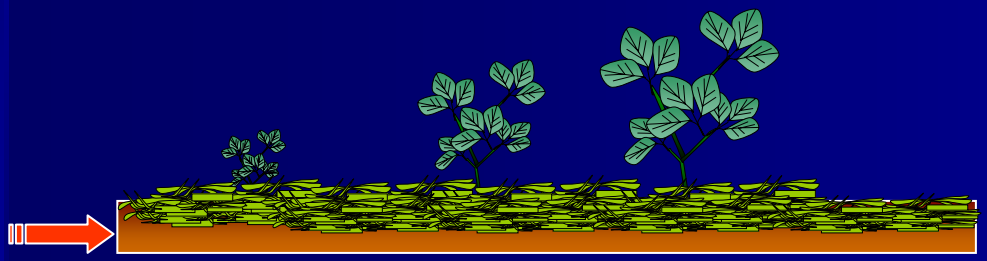
Step 2: association of Bio-pump lc with Rice and Soybean

Year n: Rice + Stylosanthes

Year n + 1: Rice + Stylosanthes

Year n + 1: Maize + …

Stylosanthes is oversown by no till planter at # 40 DAS



Year n: Soybean + Brachiaria

Year n + 1: Soybean + …

Year n: Soybean + Stylosanthes

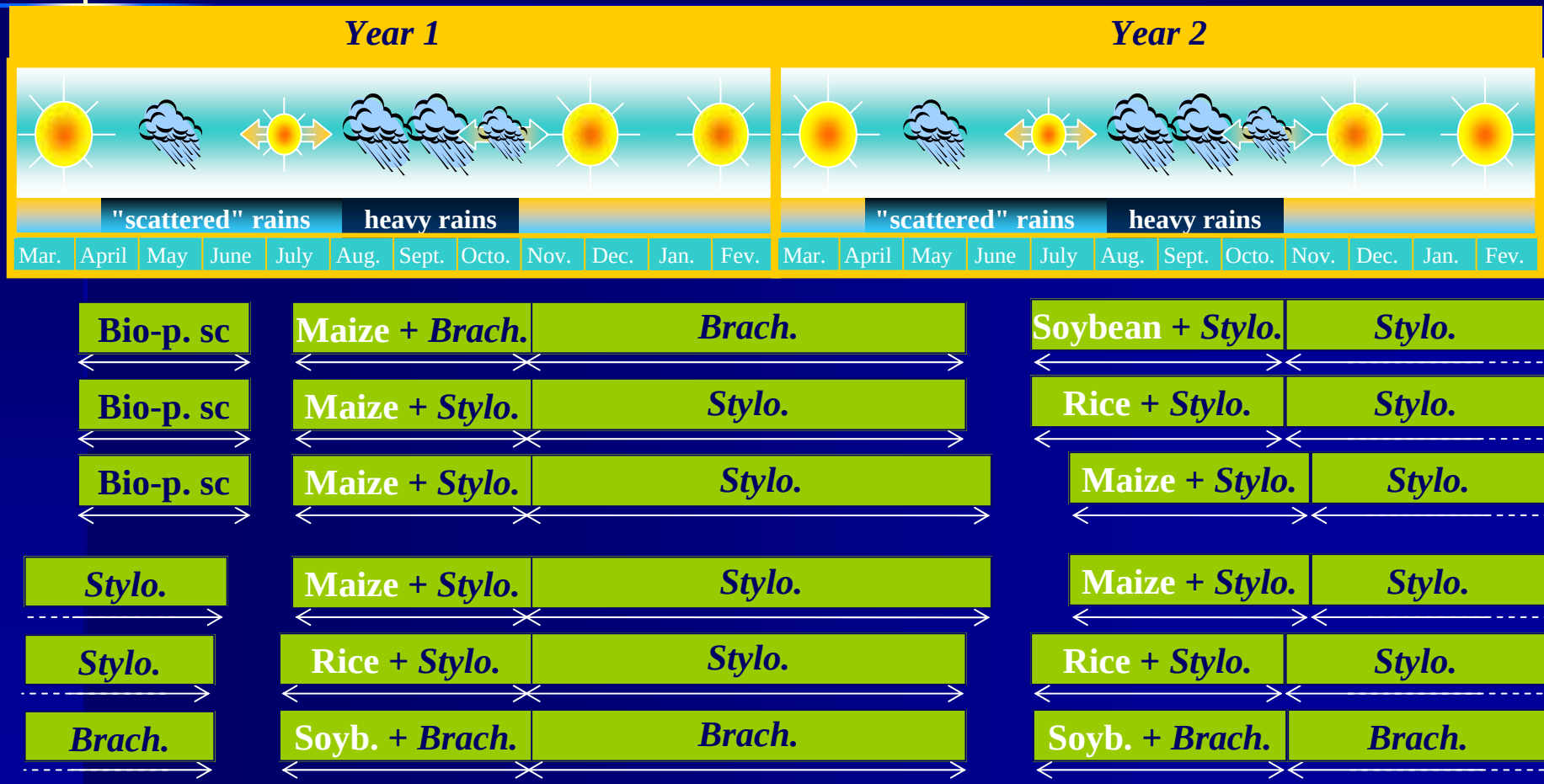
Year n + 1: Rice + Stylosanthes

Year n + 1: Maize + …

Stylosanthes or Brachiaria is broadcast sown at first Soybean’s yellow leaves appearance

2/ Progressive design of diversified DMC based systems

2.2/ The “second” generation, using long term biomass production “*LEGOLAND*”, an unlimited possibility for permanent cropping



Soybean and maize in bi-annual rotation

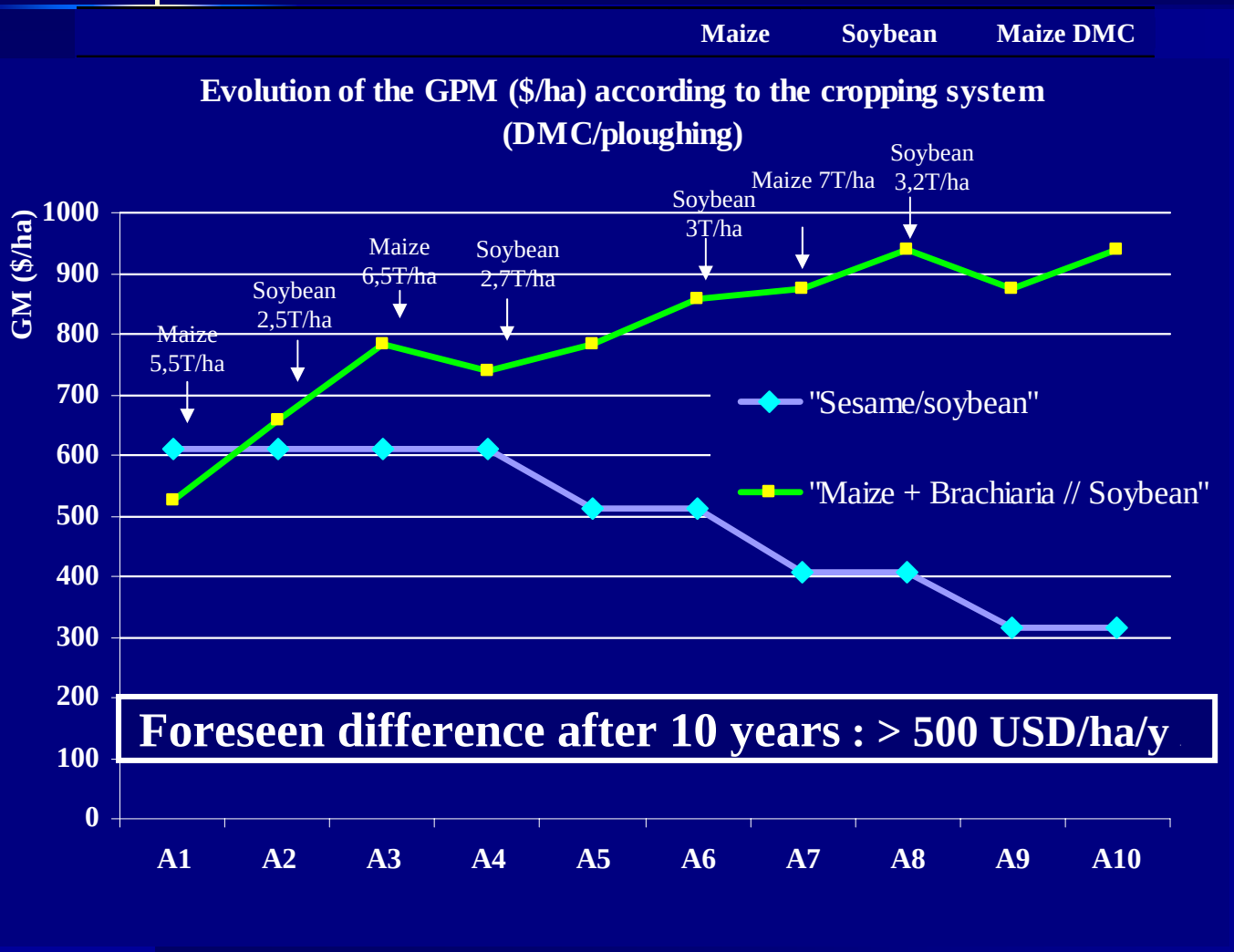
Maize mono-cropping with DMC technologies : « Maize + Stylosanthes // Maize + Stylosanthes »

Upland rice based cropping systems….

SEBOTA 68 on red soils, Bos khnor, 2007

2/ Progressive design of diversified DMC based systems

2.3/ Economical comparison between DMC Maize // Soybean rotation and Plow based Sesame / Soybean succession

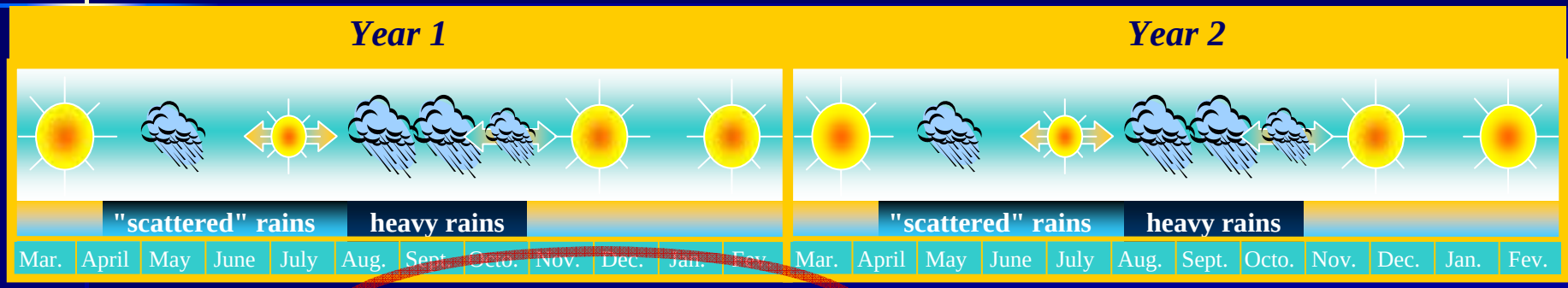


Foreseen difference after 10 years : > 500 USD/ha/y

2/ Progressive design of diversified DMC based systems

2.4/ The case of Cassava

(in french: "le cas cassava" !)



Cassava + *Stylo.* | *Stylo.* | Cassava + *Stylo.* | *Stylo.*

Reduced growth of the Stylo.
due to shade, dry soil's conditions at Cassava's harvest and early replanting in Year 2

Active growth of the Bio-pump lc

Cassava + *Stylo.* | *Stylo.* | Maize + *Stylo.* | *Stylo.*

Cassava + *Stylo.* | *Stylo.* | Rice + *Stylo.* | *Stylo.*

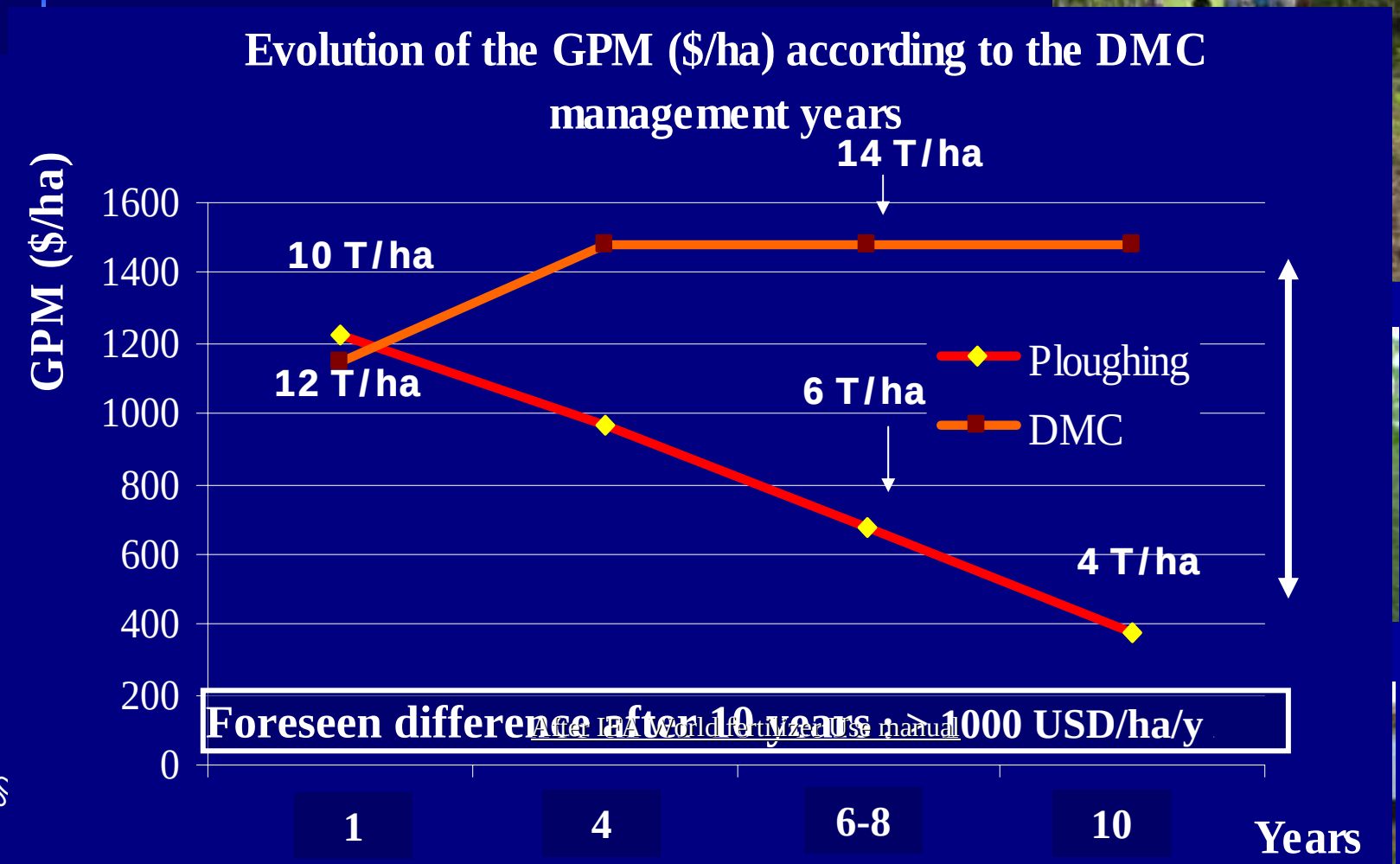
Cassava + *Brach.* | *Brach.* | Soyb. + *Stylo.* | *Stylo.*

Other attempt under assessment: alive cover of Stylosanthes guinanensis

2/ Progressive design of diversified DMC based systems

2.4/ The case of Cassava

Economical comparison between DMC Cassava and Plow Cassava



After IFA World fertilizer Use manual

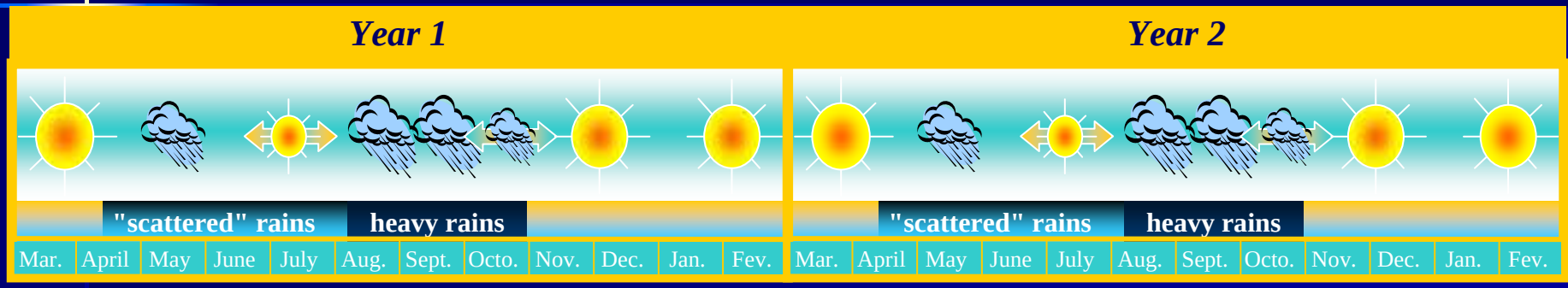
MB ($/ha)
2400
2000
1600
1200
800
400
0
30
F2 : 92-

3rd PART

Future orientations of the cropping systems' design

3/ Future orientations of the cropping systems' design

3.1/ The 2 cycles temptation



Stylo.	Sesame	Maize + *Stylo.*	*Stylo.*	Sesame	Maize + *Stylo.*	*Stylo.*
Brach	V. radiata	Maize + *Brach*	*Brach.*	V. radiata	Maize + *Brach*	*Brach.*

2nd "hazard"
small dry season

3rd "hazard"
last useful rain

Re-introduction of a high climatic risk

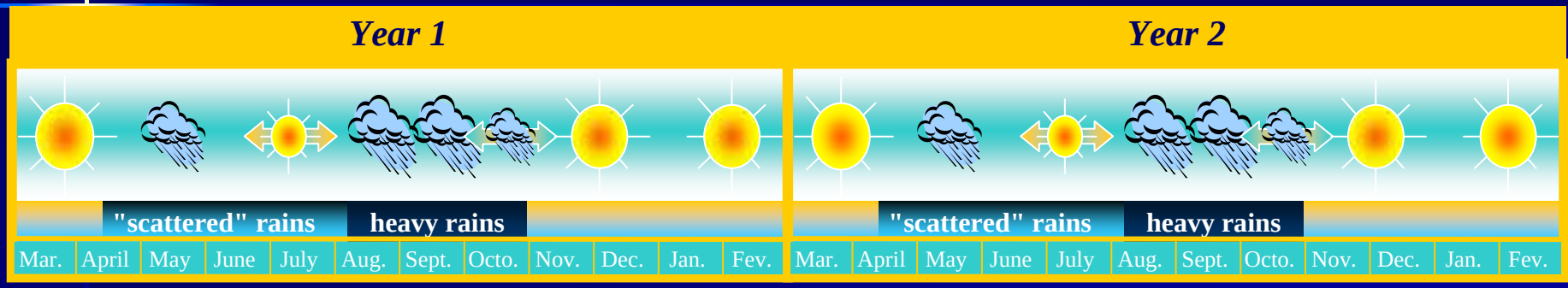
i.e. **Dependence on uncertain rainfall** ***vs*** **Securisation by soil's water reserve**

3/ Future orientations of the cropping systems' design

3.2/ Other technical evolutions

1/ Safrinhas

2/ Livestock association

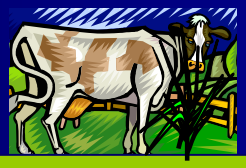


Brach. | Soybean sc | Sorgho + *Stylo* | *Stylo.* | Maize + *Brach.* | *Brach.*

Brach. | Soybean mc | *Stylo.* | Maize + *Brach.* | *Brach.*

Sorgho + *Stylo*

Stylo. | Rice sc | Mil. + *Stylo* | *Stylo.* | Maize + *Stylo.* | *Stylo.*

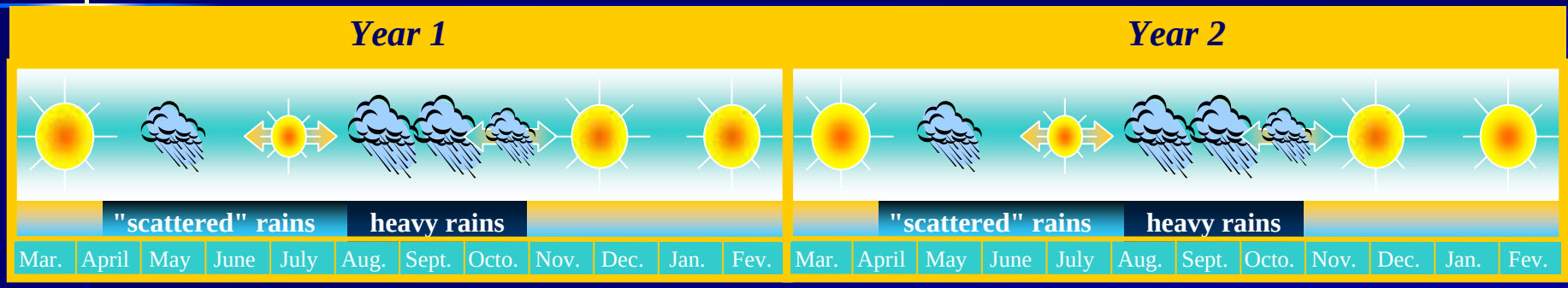


Stylo. | Maize + *Brach.* | *Brach.* | Soybean + *Stylo.* | *Stylo.*

3/ Future orientations of the cropping systems' design

3.3/ Medium term agronomical evolutions

Back to annual crops as Bio-pump sc



Mix sp.	Soybean sc	Sorgho + *mix sp.*	*Mix sp. regrowth*	Maize + *mix sp.* / *Mix sp.*
Mix sp.	Soybean mc		*Mix sp. regrowth*	Maize + *mix sp.* / *Mix sp.*
		Sorgho + *mix sp.*		

Increase the sp.-diversity in the cropping systems

in order to **Integrate "functionalities" (ecological engineering)** & **Work toward agro-chemicals reduction**

Conclusion

Parallel between DMC Creation and DMC Adoption sequences

	STAGE 1	*STAGE 2*	*STAGE 3*
CREATION	**Bio-pump sc**	**Bio-pump lc**	**Mix annual sp.**
	Weak & uncertain C input Simple management	High & secured C input Weak diversity in the rotation Simple management	High & secured C input Ecological engeneering Agro-chemical reduction
ADOPTION	**Year 1**	**Year 2 to # 5**	**Year 6 …**
	Transition to No Tillage	Entrance in DMC Simple management (learning) Rapid improvement of soil's condition (weeds, physical, chem)	DMC farmer Diversified & flexible management High quality product in fully protected environment

Limited choice of technical proposal to farmers


Document obtenu sur le site http://Agroecologie.cirad.fr


Thank you for your attention