Avoiding seasonal food deprivation in poor countries

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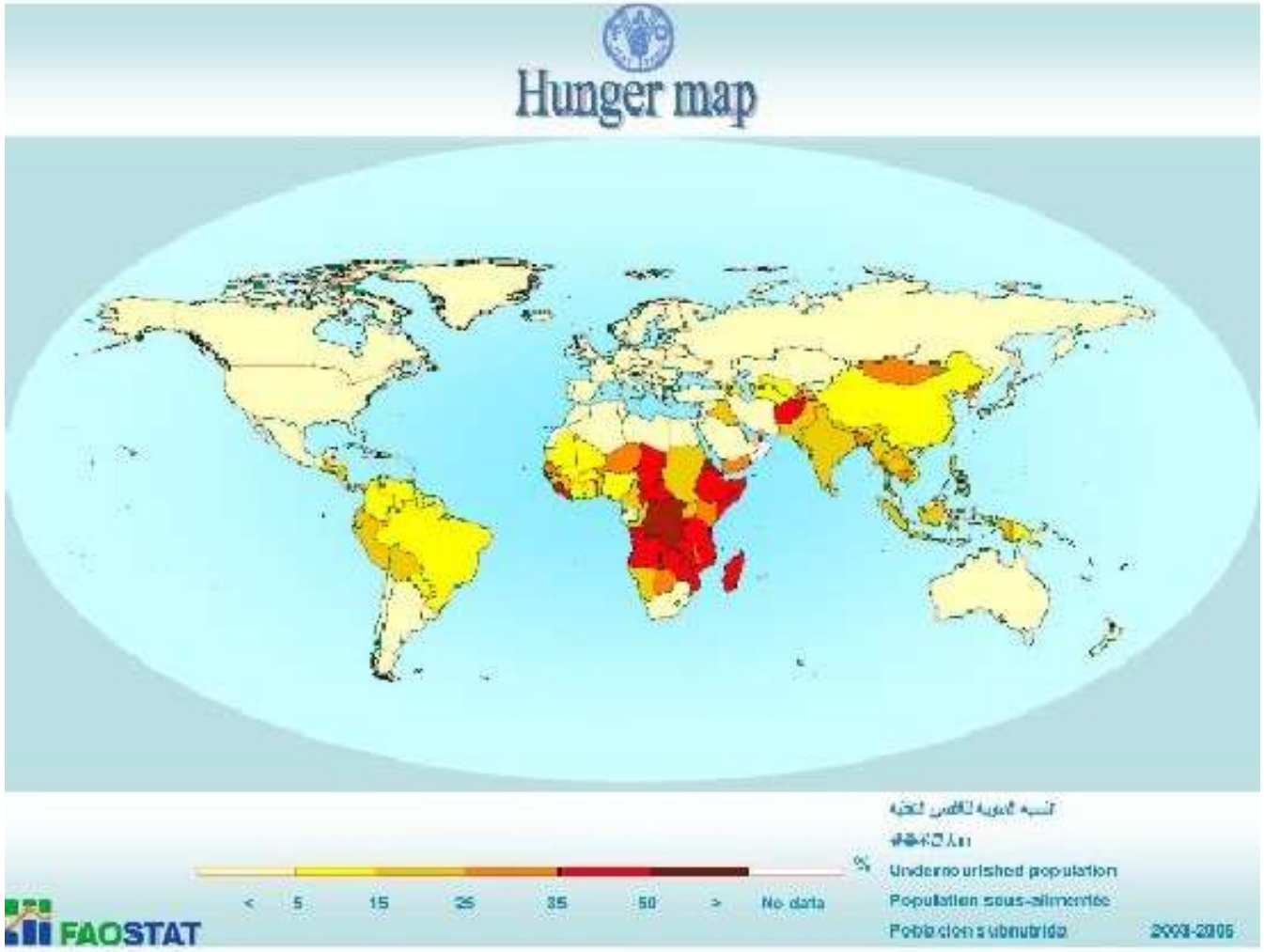
The Bottom Billion

These are the people who do not have , *at all times*, physical, and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO 1996).

The FAO Hunger Map



What Can be Done About Seasonal Hunger?

- Plant non-seasonal crops
- Diversify food crops
- Diversify the genetic base of food crops
- Process and store produce

Plant Non-Seasonal Crops

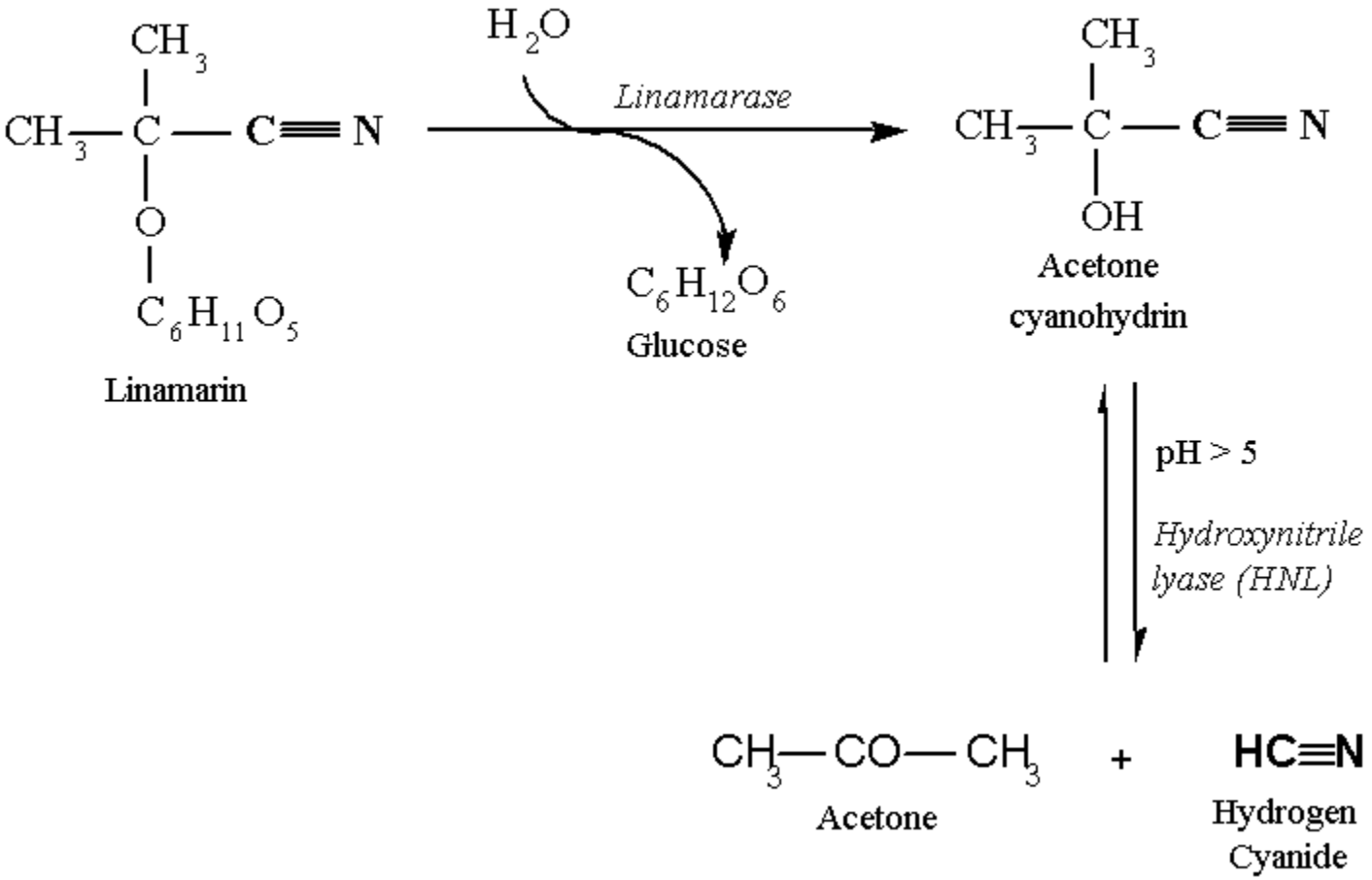
Cassava (somewhat idealized)

A Cassava Plant (for real)

The Business End of Cassava – the Tuber

Lina Marin

Linamarin


CH3
CH3 — C — C≡N
O
C6H11O5
Linamarin
H2O
Linamarase
C6H12O6
Glucose
CH3
CH3 — C — C≡N
OH
Acetone cyanohydrin
pH > 5
Hydroxynitrile lyase (HNL)
CH3— CO— CH3
Acetone
+
HC≡N
Hydrogen Cyanide

Cassava showing symptoms of African Cassava Mosaic Virus

Susceptibility of Chickpea Genotypes to Blight Caused by *Ascochyta rabiei*

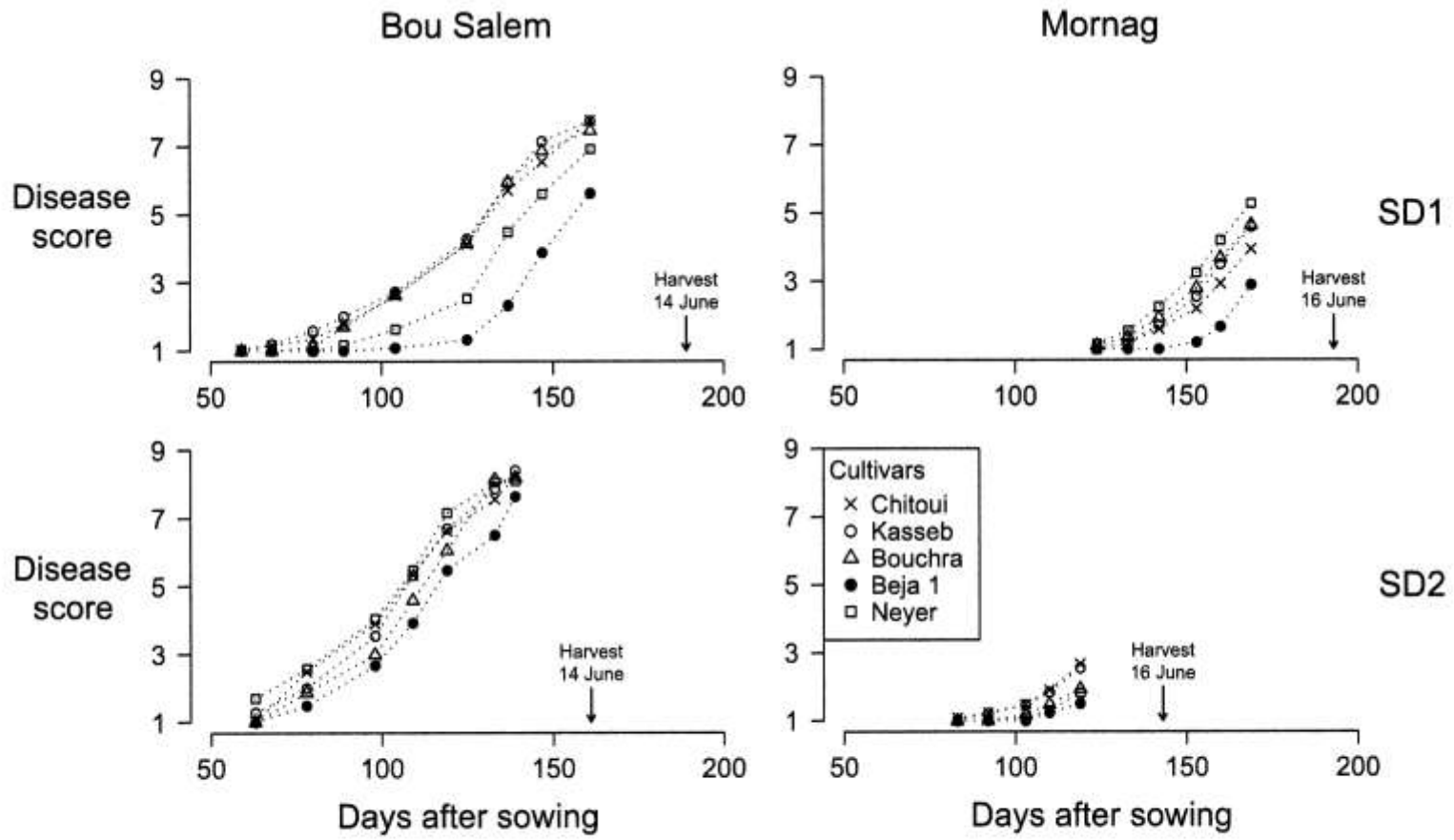


Figure 2: Progress of Ascochyta blight on five cultivars of chickpea scored on the 1–9 scale (see Table 1) on sowing dates 1 and 2 (SD1 and SD2) at Bou Salem and Mornag. Arrows denote dates of harvesting.

Diversify the cultivation of food crops

- Around 3,000 plant species consumed by man
- Now 14 make up the bulk

  Strange and Scott (2005) Plant Disease: a threat to global food security. *Annual Review of Phytopathology* **43**: 83-116.

- Why this contraction?
  - Yield
  - Convenience
  - Social mores

    Fentahun and Hager (2009) Exploiting locally available resources for food and nutritional security enhancement: a case of wild fruits in the Amhara region of Ethiopia. *Food Security* **1:** 207-219.

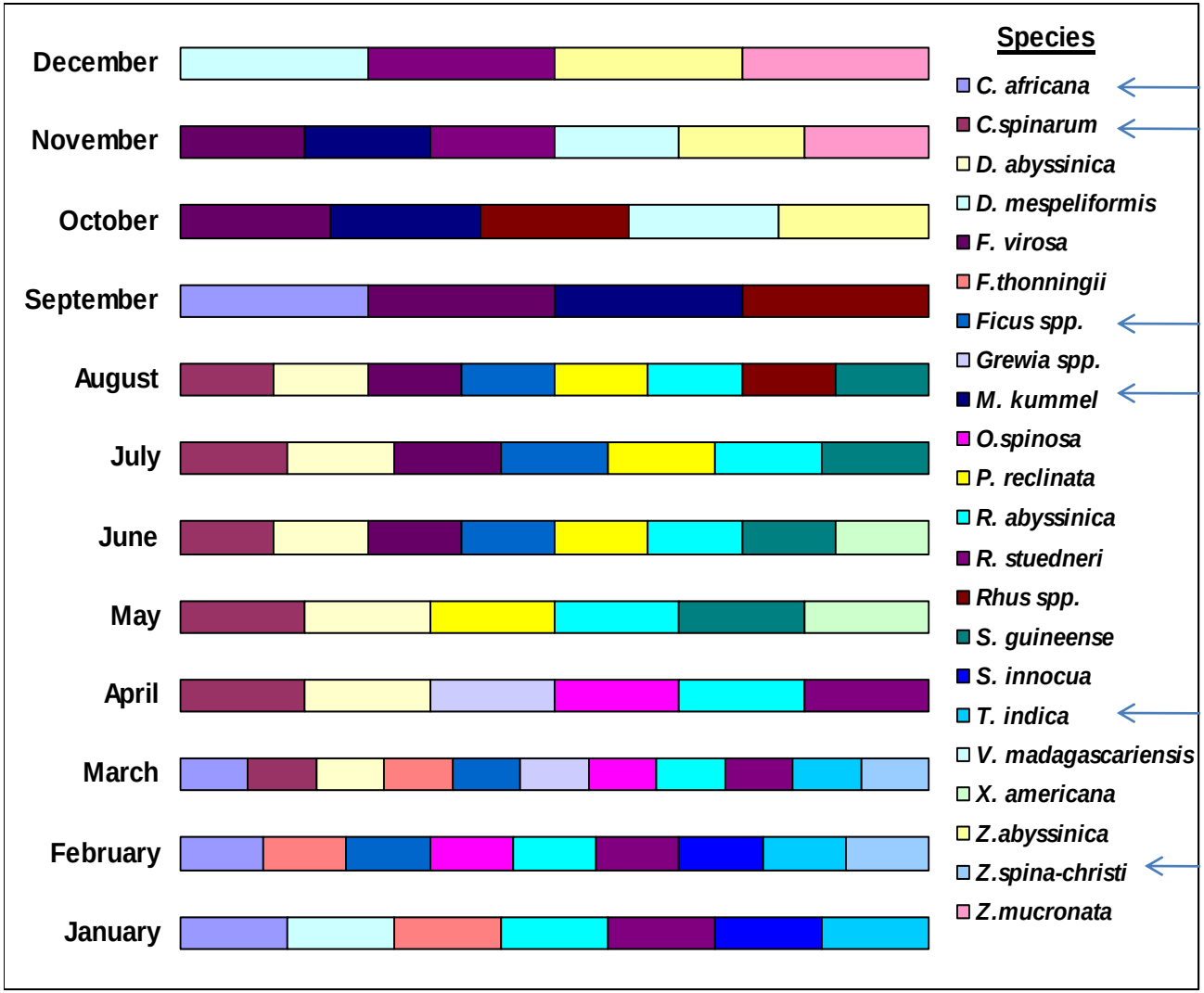
View of the Debark-Adiarkay area of Ethiopia

(photograph courtesy of Mengistu Fentahun)

Another View of the Debark-Adiarkay area

A scene near Adiarkay in the rainy season (the Simen Mountains are in the background)

Seasonal Availability of Fruit in the Amhara Region of Ethiopia



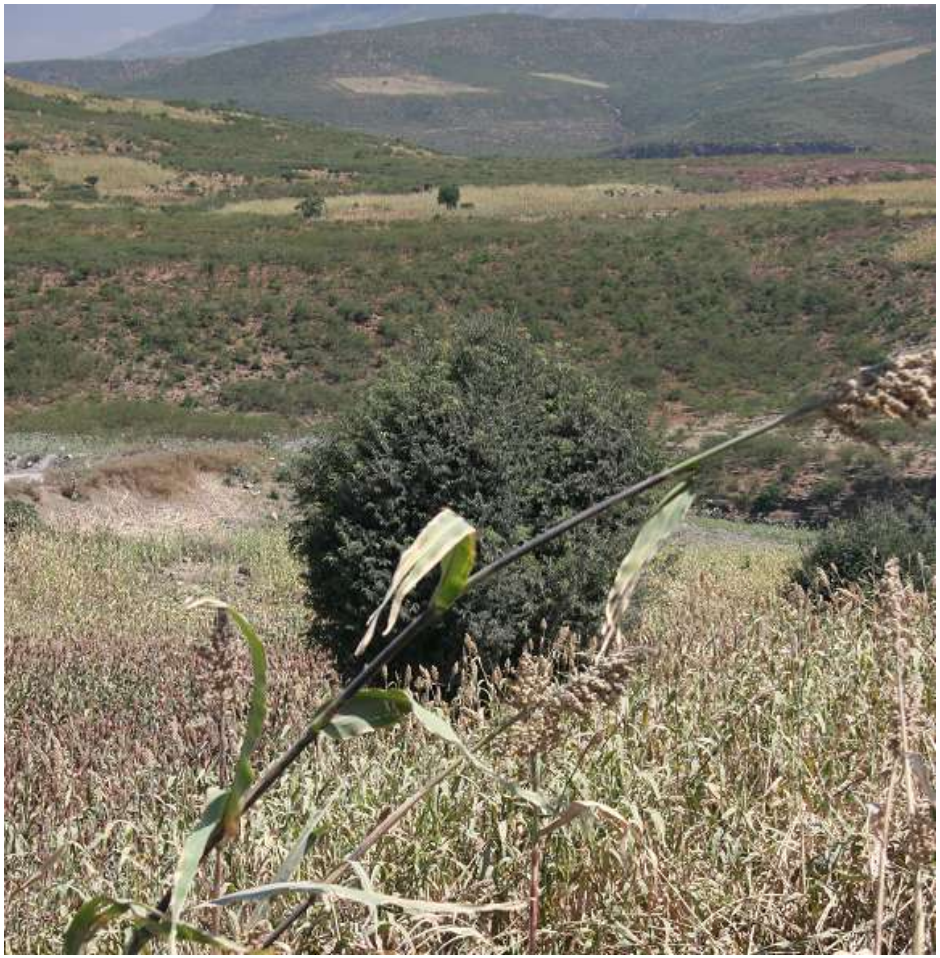
Carissa spinarum fruiting near Adiarkay

Cordia sp. Fruiting in the Adiarkay District

*Ficus sp.*fruiting in the Adiarkay District

A woman selling *Mimusops kummel* Lime and Citron fruits at Bahir Dar open market, Amhara region Ethiopia

A Tamarind (*Tamarindus indica*) bush in a sorghum field in the Kurar area, near the Blue Nile River



Ziziphus sp. fruiting in the Adiarkay District

Wild Banana (*Ensete ventricosum*)

Processing and Storing Produce

- Around 30% total of crops lost during storage in Africa (50% for fruit and vegetables).
- Need to exclude insects and larger animals e.g. Rodents.
- Need to reduce the moisture level of produce to less than 8% to prevent spoilage.

Prototype of a Drying Cabinet

Drying Cabinet Being Constructed in Mali

Mycotoxins

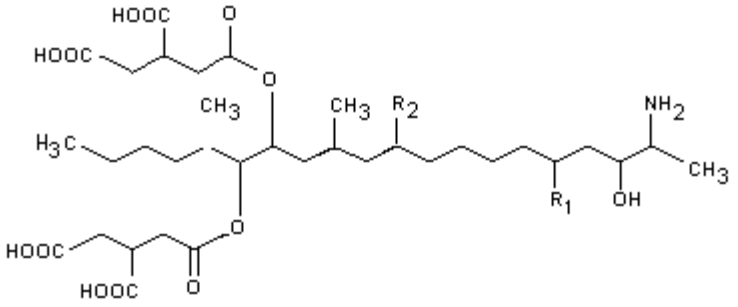
- Fumonisins

  Discovered as a result of an investigation of high incidence of oesophageal cancer in the Transkei region of South Africa.

- Aflatoxins

  Discovered originally in peanuts in the 1960s. They are toxic and carcinogenic

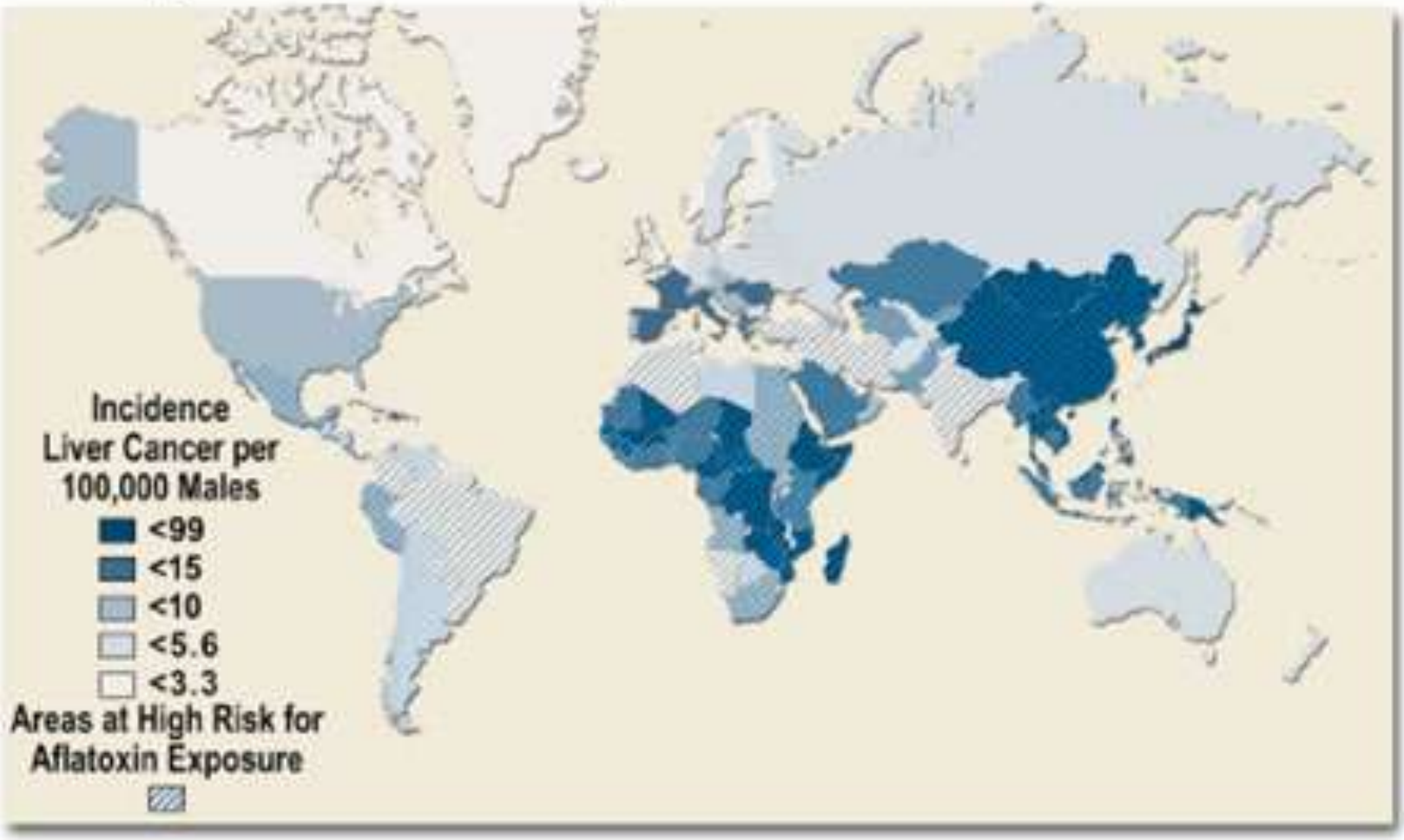
Maize Infected with *Fusarium sp.* and Chemical Structures of the Fumonisins



	R_1	R_2	Formula	CAS Number	Molecular mass
Fumonisin B_1	OH	OH	$C_{34}H_{59}NO_{15}$	116355-83-0	721.838
Fumonisin B_2	OH	H	$C_{34}H_{59}NO_{14}$	116355-84-1	705.839
Fumonisin B_3	H	OH	$C_{34}H_{59}NO_{14}$	136379-59-4	705.839
Fumonisin B_4	H	H	$C_{34}H_{59}NO_{13}$	136379-60-7	689.840

Figure 1. Chemical structures of fumonisins

Correlation Between Populations with High Liver Cancer Rates and High Risk of Chronic Exposure to Aflatoxin Contamination



Liver cancer data from the GLOBOCAN 2002 database (http://www-dep.iarc.fr/GLOBOCAN_frame.htm)

Aflatoxin data from Williams et al., Human Aflatoxicosis in Developing Countries, Am J Clin Nutr 80:1106–22, 2004.

Chemical Structures of the Aflatoxins produced by *Aspergillus flavus* and *A. parasiticus*

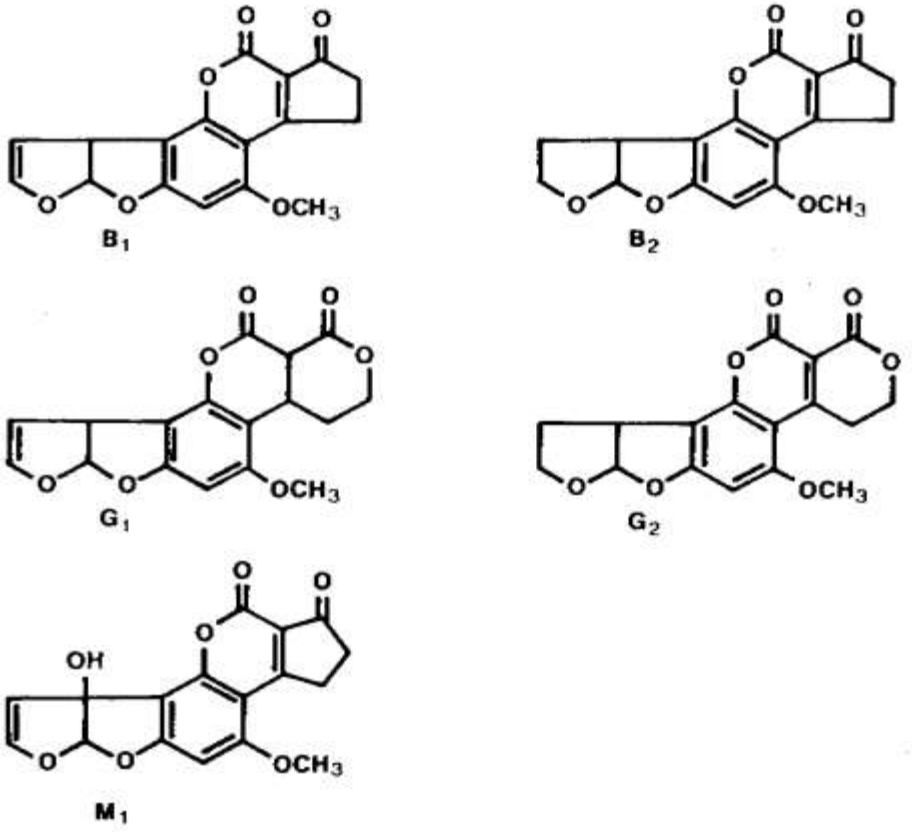


Fig 1: Structure of Aflatoxin B_1 and related aflatoxins.

What Can be Done About Seasonal Hunger?

- Plant non-seasonal crops
- Diversify the food crops we grow and consume
- Diversify the crops we already have by genetic modification
- Process and store produce *safely*