



**Making the best of 'variation'**  
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THE UNIVERSITY OF  
**WARWICK**

'Evidence-based decision  
support for food security'

15-17 April 2015

"Variety's the very spice of life, that gives  
it all its flavour."

William Cowper



# My 'theme'

- Food production is dependent on living organisms and their responses to their environment.
- 'Variation' in these living organisms and their environment offers both opportunities and challenges to food producers.
- Impacts on efficient use of resources and waste.



# Environmental variation

# Climate and the weather!



# Fears of Food Shortages Rise With Thai Floods

ARTICLE

COMMENTS (2)

FLOODING FOOD RICE THAILAND



By SHIBANI MAHTANI



— Reuters A farmer works near a flock of birds at his rice field in Ayutthaya province, Thailand, on October 12, 2011.

Southeast Asia's battle with some of the worst floods in decades is far from over, with waters seeping deeper into the Thai capital of Bangkok. But the United Nations is already warning that parts of Southeast Asia affected by the floods are facing "serious food shortages," a problem caused by destroyed crops and compounded by the difficulty in delivering food assistance.

A report from the U.N.'s Food and Agriculture Organization says that significant flooding and devastation across Southeast Asia – including Laos, Cambodia, Vietnam, the Philippines and Thailand – has caused severe damage to housing, infrastructure and agriculture.

Newsroom

Who we are

What we do

Take action

## East Africa drought questions and answers



We're seeking £9m to respond to the drought

Photo: Søren Bjerregard  
Jepsen/MS ActionAid Denmark

Severe drought across the Horn of Africa (Kenya, Ethiopia, Somalia, Uganda and Djibouti) has left over 12.4 million people in urgent need of humanitarian assistance. In some areas, the current drought is reported to be the worst in over 60 years.

# Influence of the weather on 'demand'

## Warm weather sees sun cream, salad and cider sales soar at Waitrose

PUBLISHED: 09:31, 3 May 2013 | UPDATED: 09:58, 3 May 2013



Soaring sales of sun cream, salad and cider contributed to an an 11.1 per cent rise in first-quarter sales at Waitrose, figures showed today.

The upmarket grocer, which said that online sales surged 50.1 per cent during the quarter, seems to be defying the squeeze on consumer spending.

For the first time more than five million customers visited its branches per week, Waitrose said, and customer transactions were up 8.4 per cent.



## The Telegraph

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## Dust off the barbecue as forecaster predicts warmest weekend yet

Temperatures expected hit 20C (68F) in some parts of the country over the weekend after freezing weather brought snow to Dartmoor

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# Influence of the weather on 'supply'

## NEWS

### Heat leaves UK facing pea shortages next year

The UK is in danger of running out of peas well before the 2007 harvest, leading distributor Christ-

remain an option, and there are issues of limited expensive tonnage due to shipping costs and food

### Mild weather is cause of spud storage headaches

By Paul Speckman

Storage problems triggered by an unusually mild autumn mean potato growers may need to re-evaluate marketing strategies this season, experts advise.

"We are, sprouting and second-year growth are all bigger problems than normal, particularly for crops in southern areas to meet southern parts of the UK, says Adrian Cunningham from the British Potato Council's Sutton Ridge.

"We've got a lot of variable quality. The mild conditions mean we are not getting the same temperature down, which has triggered a few wet rot problems and is not helping the dormancy situation."

When no irrigation was available, a lot of secondary growth was also seen and this is starting to break down in some, he says.

Chlorophyllase (CHC) sprout suppressors should be made a priority to control sprouting, he continues. "But be careful, because



Variable quality of crops going into store and recent mild weather means growers may need to rethink marketing strategies, say experts.

pot-quality potato chip producer down processing more than usual this

year hot and dry June and July, combined with an August, severely growth throughout. Overall potato production was estimated to be 10 per cent in 2006 – having a knock-on

effect on its plants in the north and Whittlesey for because it expects to be low at the end of the season. A representative has been taken to

ensure the quality of the plant and to ensure the quality of our finished products. It will not impact on



regularly for chipping – although prices have begun to stabilise. But the shortage has left McCain concerned about end-of-season potatoes.

Wortley has benefited from high prices, especially the Markies variety

seeing a bit of a steadier effect. In the bag-chip trade we are seeing resistance from customers for further increases."

Potato grower John Wortley of Crowland Fresh Produce, near Peterborough, said: "When the rain eventually did come in August 2006, potatoes formed another tuber and this carried a late, immature potato. They were immature tubers, and dry matter testing showed they were very watery." For many this meant that once they were fried for chips they ended up with white and dark brown chips.

But Wortley said his company's on-site reservoir helped during the dry period, maintaining quality, and the firm had been benefiting from the high prices as a result.

The Markies variety has been particularly profitable – fetching up to £320 per tonne consistently.

## NEWS

### Veg yields hit by heat

The hot weather, following on the back of a cold and wet spring, has seriously affected both yields and harvest times for vegetable growers, the NFU has said.

A number of cauliflower growers have reported yield reductions of up to 40% for

would lead to secondary growth and poor formation of the actual sprouts, meaning that yields of the crop will be down, although there is more optimism that those for later production will be alright.

The situation on vining peas is quite serious, with yields down and up to 70% of normal

**BBC NEWS** | BBC News in video and audio

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Last updated: Saturday, 11 November 2006, 13:36 GMT

Warm winters 'ruin' currant crop

A Herefordshire farmer is warning of a shortage of blackcurrant squash and jam claiming global warming has affected his crop.

Edward Thompson, from Ledbury, said he first noticed a mild winter in 1998 meant only half as much fruit grew but he was baffled as to why.

### Warm winter means early sprouting threatens potato stores

Potatoes in store are at high risk of early sprouting due to record warm winter temperatures, a leading farm advisory service has warned.

Frontier Agriculture technical manager Les Sykes said growers should be alert for signs of early dormancy break following a scorching summer and warm winter which has seen few frosts to aid storage temperature draw-down. "This is a very bad year for sprouting. We started the season in a very difficult situation and it's been hard to keep on top of sprouting due to unusually high temperatures," he said.



In store: a very bad year for sprouting

Sykes said late-harvested wet crops are particularly vulnerable and advises regular store checks: "Be vigilant – look throughout the store every week and dig down into the crop to see what's happening." Application of growth regulators will help control the problem but

growers should be aware of new residue limits for potatoes in store. Chemical producer Luxan has set up the STAR Initiative (Storage Treatment and Residues) and is urging growers to sign up to be kept informed on regulatory changes.

As Grower goes to press industry figures are meeting in Marston, Lincolnshire, for the Potato Storage Conference 2007. The British Potato Council-hosted event focuses on the key challenges facing the industry, giving growers an insight to the latest research and developments. See next week's Grower.



# Lettuce - UK industry indicated that there would be a negative impact on quality following:

- Heavy rainfall
- High temperatures
- Low temperatures
- Differences in day/night temperature less than 8°C
- Can build mathematical models to describe relationships

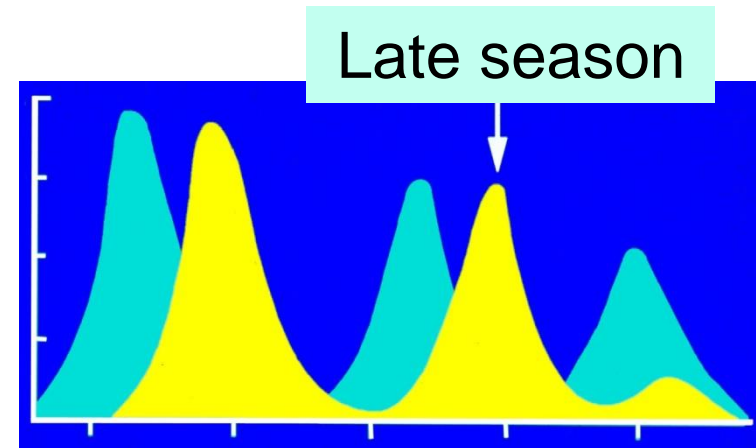


# Pests and diseases



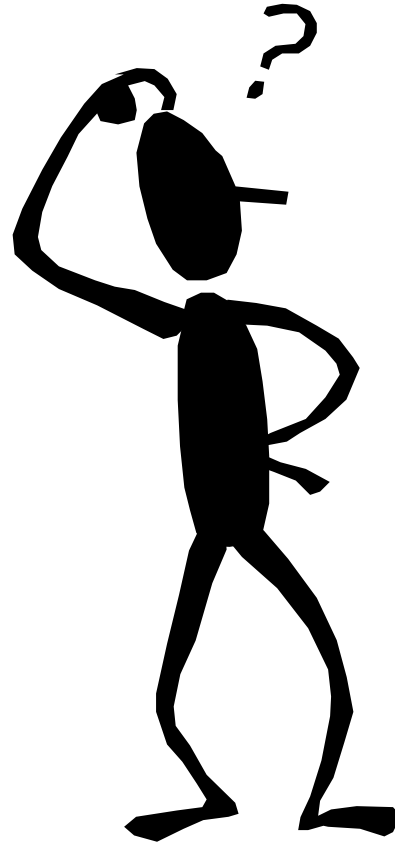
Incidence very dependent on weather

Weather affects survival and rates of development and reproduction - mainly through temperature and 'wetness'



Again, can build mathematical models

# Decision support



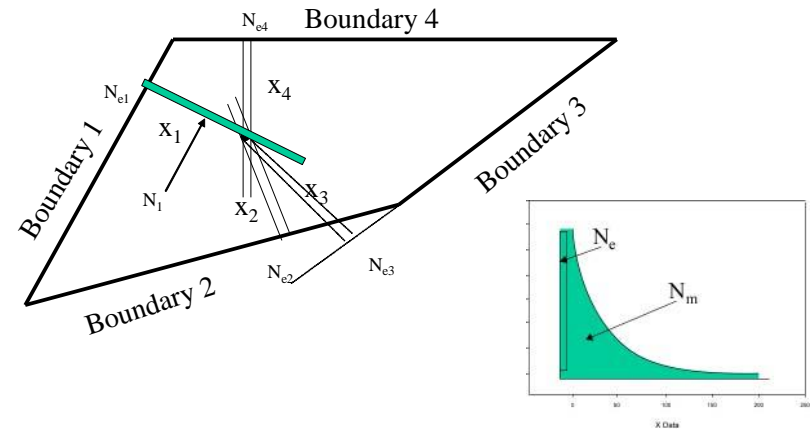
# Decision support – short term

Monitoring to predict pest and disease incidence

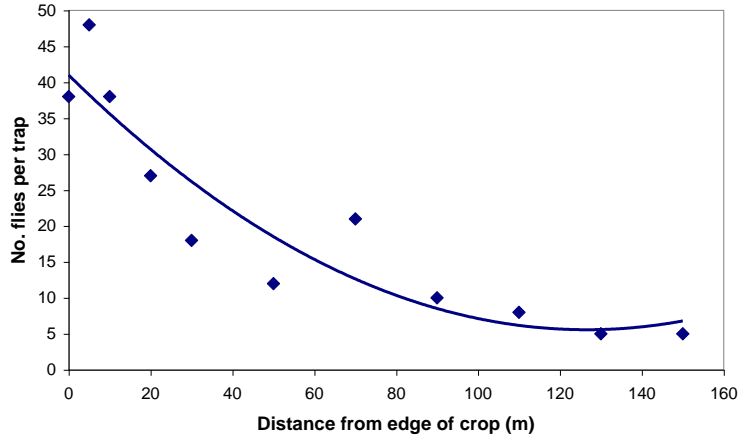


Carrot fly





Single transect from edge of crop



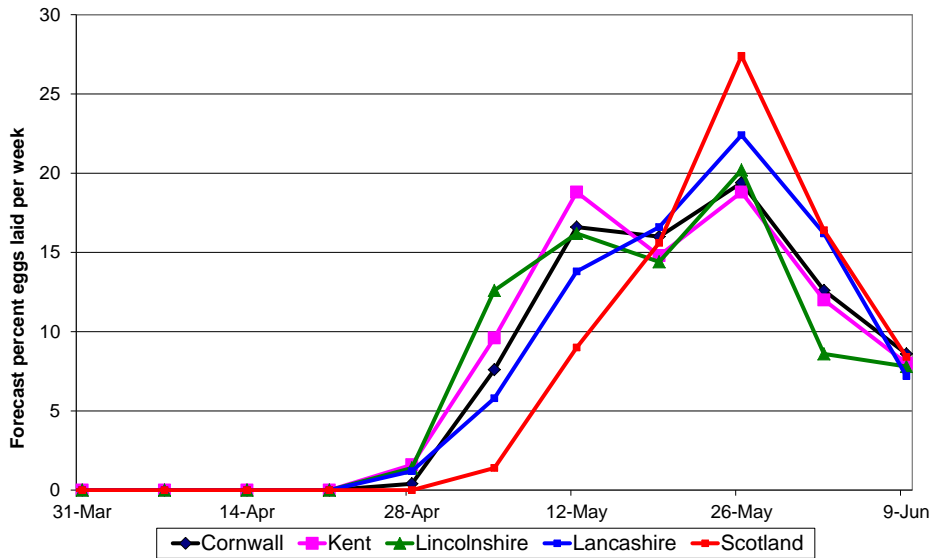
$$\log \hat{N}_m = \log N_e + \log(\Gamma(k)) - k \log b - (k-1) \log 0.1 + 0.1b$$

$k=0.93, b=0.022$  mean distance travelled = 42.3 m

# Decision support – short term

Using models and weather data to predict pest and disease incidence

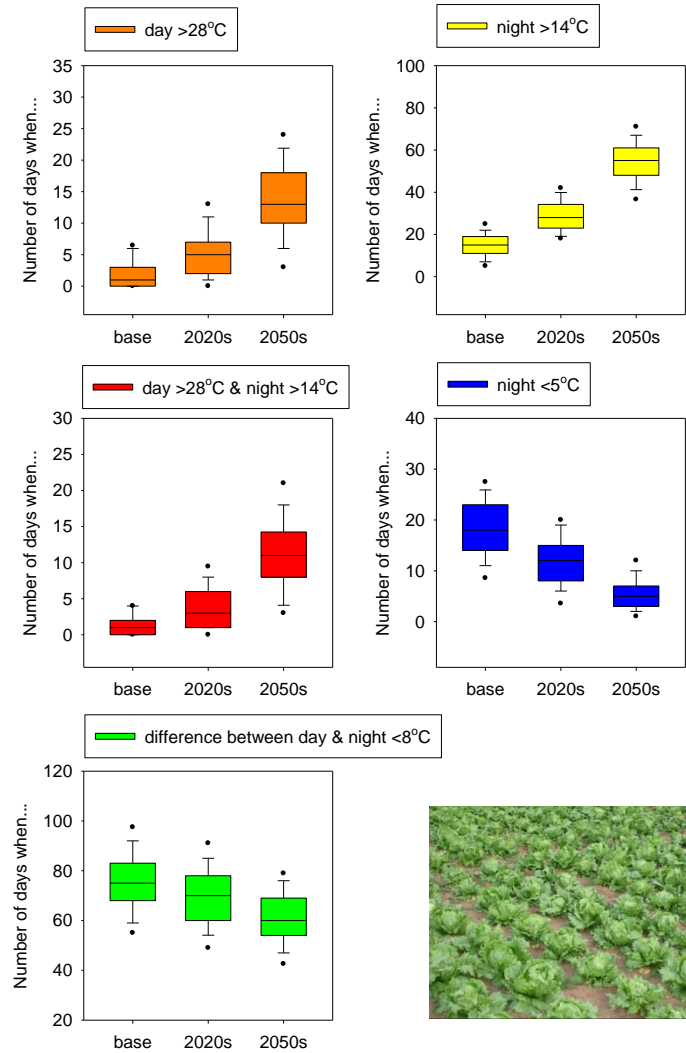
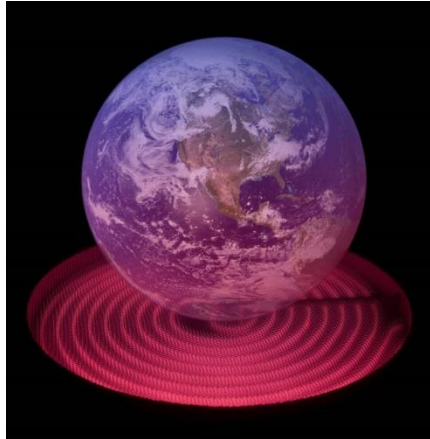
Carrot fly



The screenshot shows the Syngenta HDC Pest Bulletin website. The page features a navigation menu at the top, a search bar, and a sidebar with 'Agronomy Tools' including BlightCast, HDC Pest Bulletin, and various calculators. The main content area is titled 'HDC Pest Bulletin' and includes a 'Weekly reports for the 2015 season will start in April' announcement. Below this, there are sections for 'Brassicacis' (Cabbage Root Fly, Caterpillars, Pollen Beetles, Aphids, Flea Beetles) and 'Carrot & Parsnip' (Carrot Fly, Aphids). Other sections include 'Cutworm Info', 'Leek & Onion' (Thrips, Bean Seed Fly, Leek Moth), and 'Agronomy Tools'. The right sidebar contains 'Agronomy Tools', 'HDC Pest Blog', and 'Sign up for BruchidCast'.

# Decision support – long term

Using climate models to provide weather data



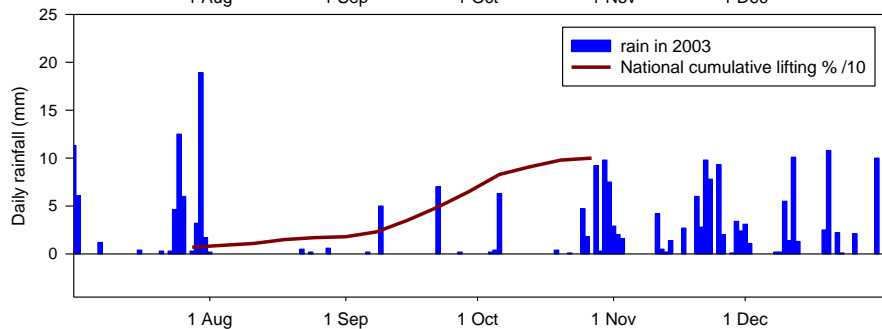
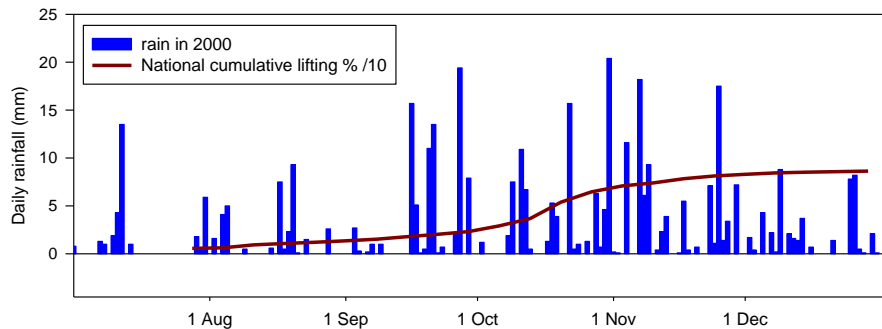


# Potato harvest - UK

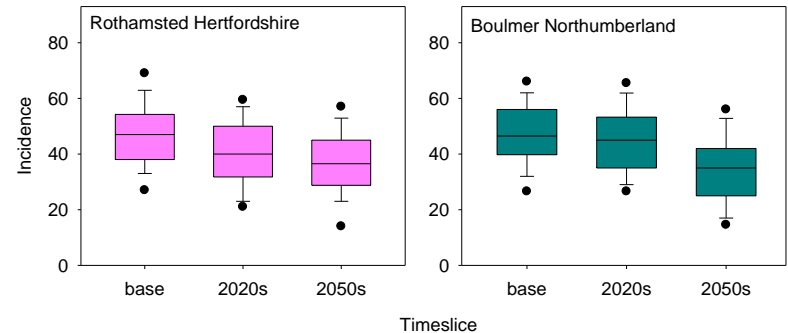
Using climate models to provide weather data



© Etc food blog

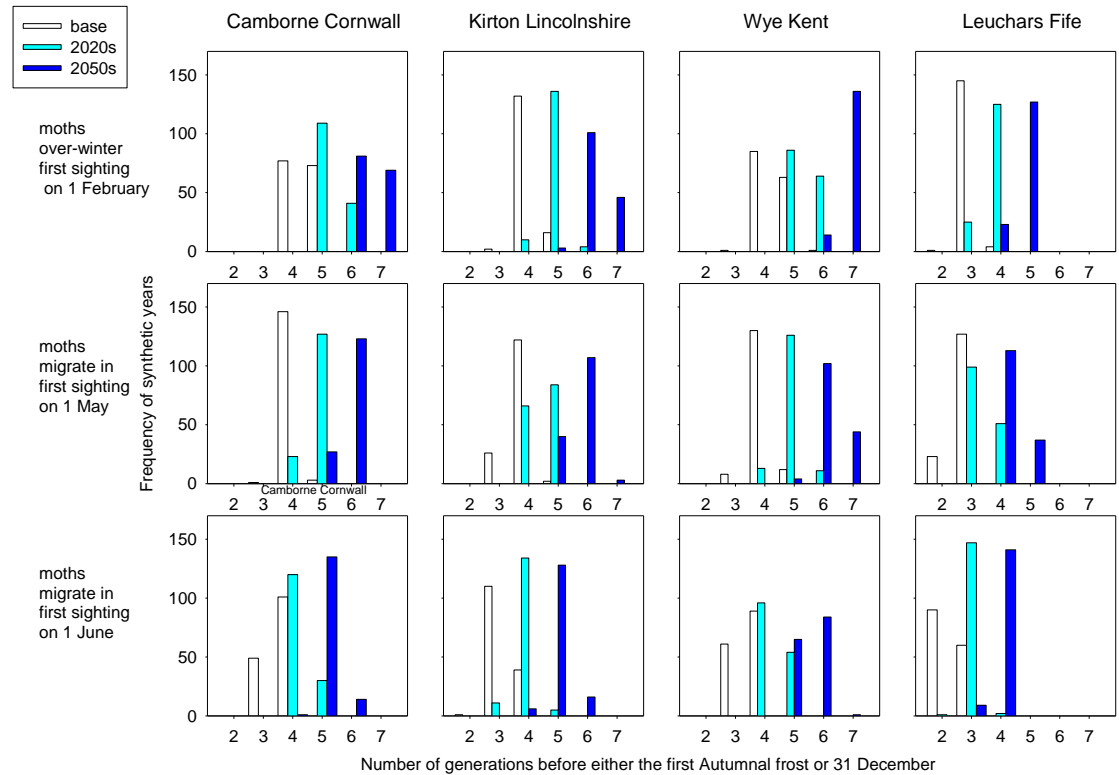


Incidence of runs of 7 days with an accumulated rainfall total of 10 mm or greater between 1 August and 31 October



# Number of generations of diamond-back moth

Using climate models to provide weather data



# Biological variation



# Current commercial crop cultivars provide uniformity and are grown in monocultures

- Ease of growing
- Consistent size and quality
- Ease and costs of harvest



# Uniformity = vulnerability?

- All plants respond in same way
- Currently selected for high input conditions (fertiliser, water, pesticides)
- In longer term may need 'resilience' – within and between crops
- Genetic variation in wild hosts and old varieties may be source of 'resilience'



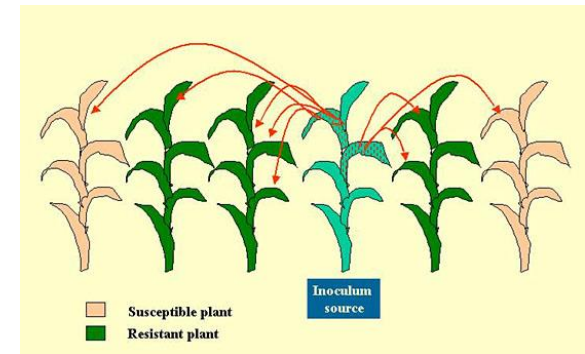
# Pest and disease populations also genetically variable

- High selection pressure from pesticides or host plant resistance may lead to selective advantage for individuals that can overcome them
- Evolutionary arms race...
- Modelling can help with management



# Mixtures - cultivars!

- “Mixtures of cultivars that vary for many characters including disease resistance, but have sufficient similarity to be grown together.” (Wolfe, 1985)
- No major changes to the agricultural system, generally increase yield stability, and in some cases can reduce pesticide use.
- May be similar for important traits including maturity, height, quality and grain type. Depending on the agronomic practices and intended use.



**American Phytopathological Society**

# Mixtures - species!

- Used extensively in some parts of the world – especially intercropping
- Maximises use of land – may get increased yield per hectare
- Spreads ‘risk’
- Other possible advantages
  - Increased nutrient use efficiency
  - Increase water use efficiency
  - Weed suppression
  - Pest suppression
  - One crop ‘shelters’ another – provides better growing conditions





Pearl millet-Groundnut Source: ICRISAT



Source: Organic Garden Info.com



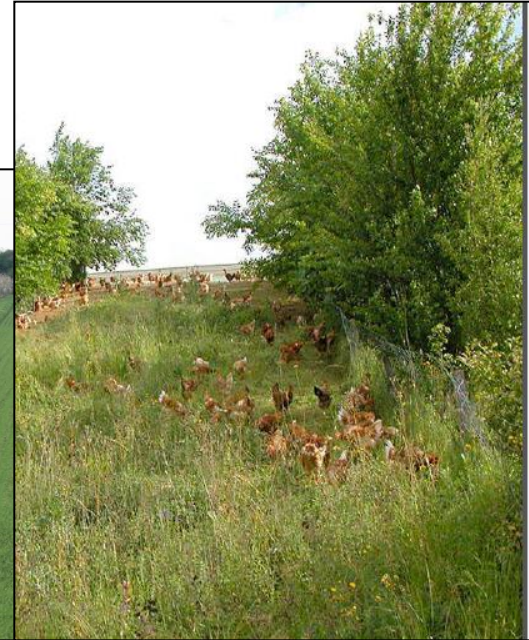
Source: ICIPE



Finger millet and sugar cane  
Source: Bio-dynamic Association Of India

# Agroforestry

- 3D farming!
- Improved soil & water protection
- Improved habitat
- Multi-functional land use
- Multiple crops & harvests – less risks?
- Multiple market outlets
- Wood – fuel bonus
- Climate change mitigation



# The future for evidence-based decision support for food security!

- Long range weather forecasting?  
Climate forecasting?
- GPS, GIS, precision farming –  
planting, treatment, harvesting?
- Genetics and genomics
- Plant, animal and environmental  
science!



© US National Archives



© Daddy's tractor

# With thanks to:

- Defra
- Horticultural Development Company
- My colleagues



The UK Vegetable Gene Bank @ Warwick