

Environmental Risk Assessment of Herbicide Tolerant GM plants.

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EC GMO Regulations

- **2001/18/EC: Impacts of changes in cultivation, management and harvesting techniques associated with the GMO**



ERA include environmental impacts of the specific cultivation and management of GM plants.(cf conventional plants)

ERA GM herbicide tolerant (HT) crops : evaluate the environmental consequences and impact of herbicide programmes associated with GMHT crops, (+ environmental impacts of GM plant itself).



GUIDANCE DOCUMENT
OF THE SCIENTIFIC PANEL
ON GENETICALLY MODIFIED
ORGANISMS FOR THE RISK
ASSESSMENT OF GENETICALLY
MODIFIED PLANTS AND
DERIVED FOOD AND FEED

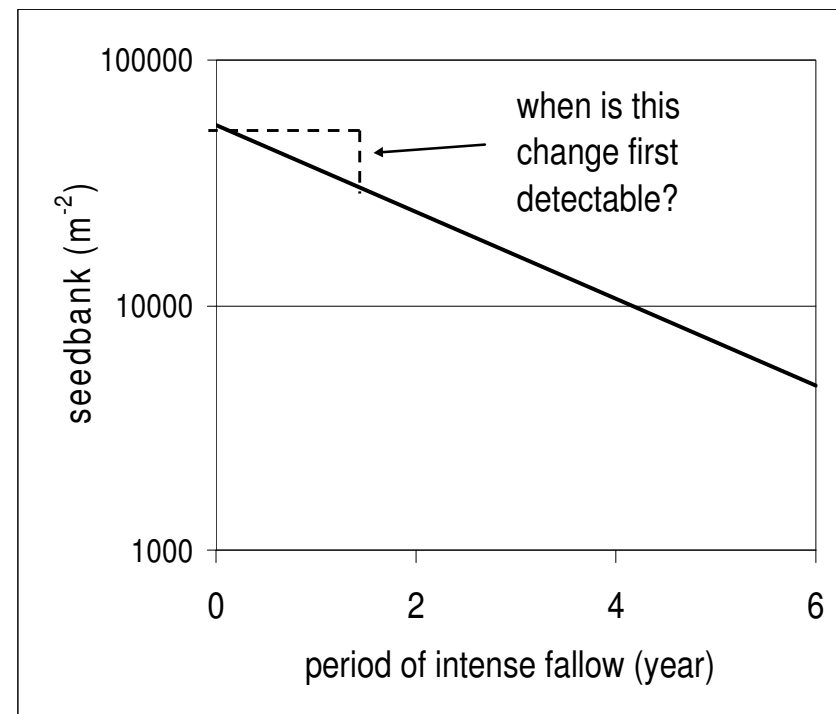
Adopted on 24 September 2004
First, edited version of 9 November 2004

Being revised in 2010



Seed bank decline

- Abundance falls logarithmically when all plants are prevented from re-seeding
- Change was originally detected after 2 years in earlier field experiments (1920s to 1950s)



Brenchley & Warington 1933
Roberts 1958, 1962

- **Herbicides exclude most weed plants from crop and immediately surrounding area**
- **Crop contains little botanical diversity (species x number of plants)**
- **Base of food chain removed – effects food chain**
 - → **reduction in diversity (sp x n) of phytophagus spp (incl. fungi, bacteria, arthropods etc..)**
 - → **reduction in diversity of other species: predators, parasites etc...**
- * **Main cause of reductions in farmland biodiversity in Europe (inc. farmland birds)**

Env effects of herbicides depend on :

- Active ingredient (contact, systemic, residual, broad spectrum, selective, etc.)
- Formulation and additives (surfactants, wetters, etc)
- Tank mix (other pesticides etc..)
- Amount applied (dose),
- Number of applications
- Timing (in relation to plant development)
- Targeting and precision < > Drift
- Other agronomic practices (No Till systems)
- Crop rotations

Effects of GMHT Management

Considerable research data has shown potential for GMHT crops to change botanical and bio-diversity.



- **UK Farm Scale Evaluation of HT crops**
- Recognition that main Env impacts will come from the use/management of the herbicides
- Therefore ERA of GM plant + management

Management more important than a.i.

- Careful management of glyphosate > less Env harm than excessive use of more selective H.
- Allows minimum tillage
- More targeted application... better precision.
- Management measures* being applied to H in many MS to reduce environmental impact..
 - Unsprayed margins of fields (eg 6-12 m)
 - Max dose & no of applications
 - Timing & frequency of use in crop or rotation
 - Drift control measures (droplet size, wind conditions)

* **Legal Requirements with penalties**

**Elmegaard N. &
Bruus Pedersen M.
NERI (2001)**



Figure 1. The six field sites included in the study.

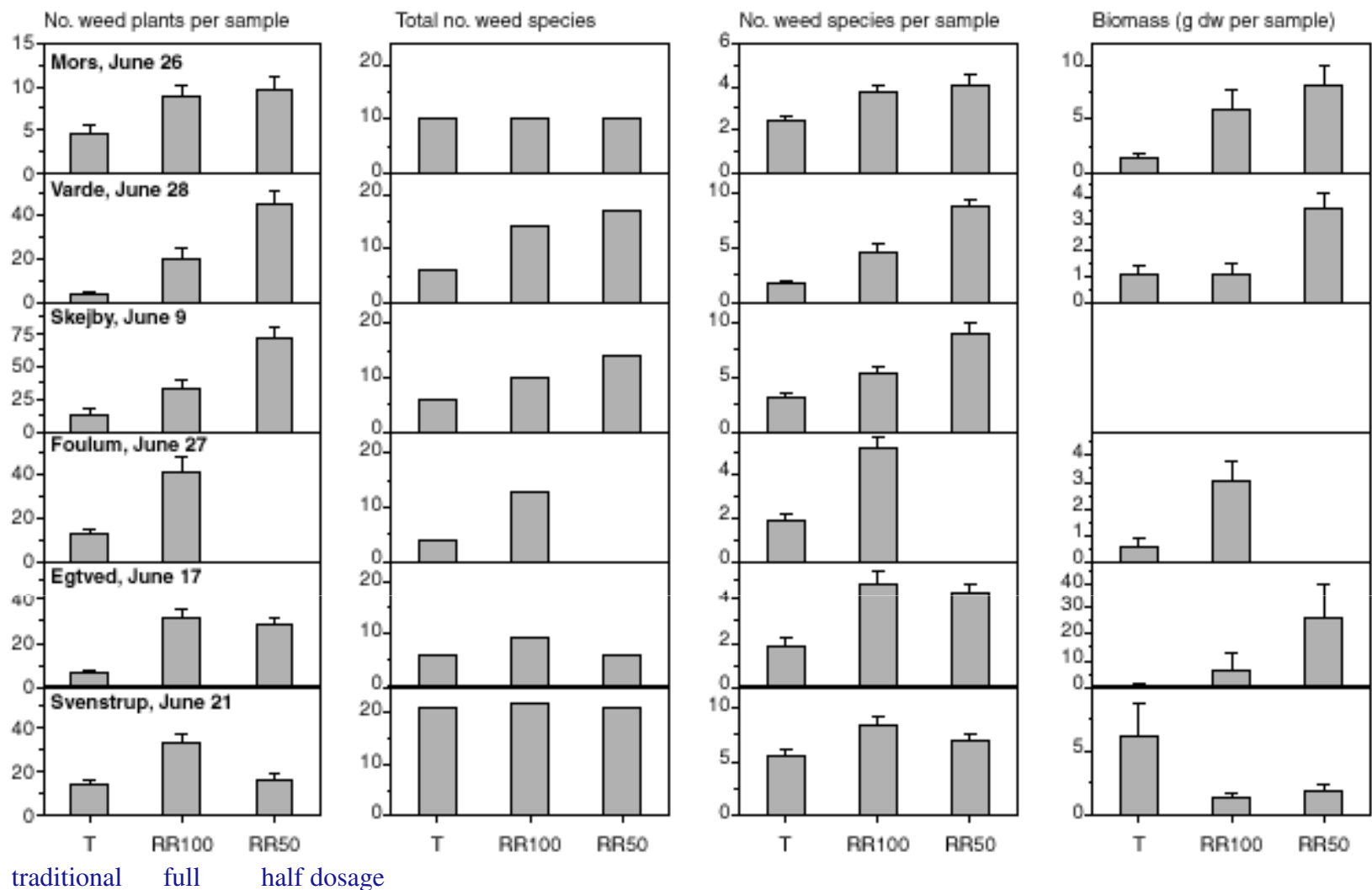


Figure 2. Number (means and SE) of weed plants per sample of 0.25 m² (first column from the left), total number of plant species per treatment (second column), number of plant species per sample (third column) and total weed biomass per sample (right column, no data for Skejby) at the six sites. At each site three herbicide regimes were represented, viz. Roundup tolerant beets sprayed with half dosage (RR50, not at Foulum), Roundup tolerant beets sprayed with full dosage (RR100), and traditionally sprayed beets (T). Within each field and treatment, 10 samples were collected, except for Skejby (4-7 samples) and Egtved (7-9 samples). Labels indicating sampling site in the left column are valid for all four columns. Note that scales may differ between sites.

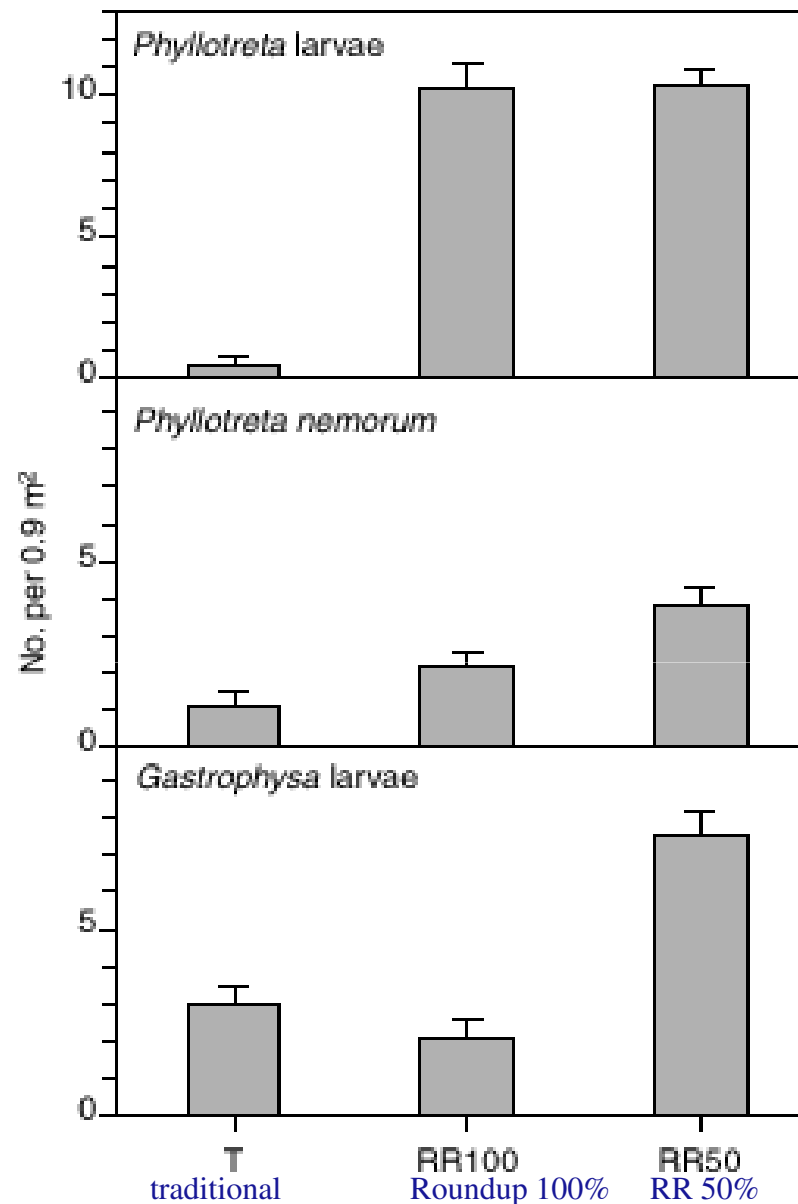


Figure 3. Density of *Gastrophysa polygoni* larvae, flea beetle larvae and *Phyllotreta nemorum* in the traditional (T) fodder beet plot, RR100 plot and RR50 plot at Skejby. Bars indicate standard error of means.

- Extensive and /or repeated use of same H →
 - Development of resistant weeds
 - Shifts in weed populations to those that avoid the Herbicide.

Management consequences:

- Increased use of Herbicide
- Use of Herbicide mixtures

Environmental Effects:

- Reduction in weed diversity (biomass x Spp.)
- Reduction in Biodiversity

Introduction of GMHT crops into European agriculture

- **Should learn from mistakes in N and S America and 50 years of Herbicide use worldwide**
- **Not feature extensive overuse of 1 HT system**
- **Should be introduced sustainably into EU agric systems considering:**
 - **Crop ecosystems**
 - **IPM**
 - **Weed resistance management**
 - **Volunteer control**
- **AgChem and BioTech Co's should develop and promote clear strategy and framework for EU farming regions and systems.**
- **Stewardship of GMHT crop and Herbicide fits within this framework**

GMO Panel concluded :

- **Herbicide Management could result in loss of biodiversity and cause environmental harm.**

GMO Panel recommended :

- **Herbicides are managed so as to maintain or improve current levels of biodiversity in crops and fields.**
- **Risk managers (eg CAs and EC), together with Applicants, put in place appropriate management systems for use of the herbicides on GMHT crops.**
- **This should be done under existing pesticide regulations and regimes operating in MS.....**

Proposed procedure :

- 1. The potential environmental impacts of the recommended herbicide management systems should be compared with those currently observed in equivalent non-HT crops and non-GMHT crops.**

2. ERA should consider whether the use of the herbicide could result in reductions in biodiversity leading to environmental damage greater than non-HT crops and non-GMHT crops.

- 3. The applicant should consult the appropriate CA's dealing with environmental protection, farmland biodiversity and pesticide registration in each MS on: GMHT herbicide programmes that optimize weed management while maintaining adverse environmental impacts at or below current levels, and which are in line with environmental protection goals and biodiversity action plans of each MS. The applicant should consider developing herbicide management strategies to prevent potential adverse effects to both crop and adjacent non-crop environments. (eg unsprayed headlands)**