

Impact of climate change on the geographical spread of agricultural pests, diseases and weeds

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INTRODUCTION

A number of economically important pests, diseases and weeds have been demonstrated to be spreading or moving as a consequence of changes in weather patterns within both Europe and North America. New pest arrivals within the EU include western corn rootworm (WCR) (*Diabrotica viginifera viginifera*) into the UK in 2003; there is also the continued threat of Colorado beetle (*Leptinotarsa decemlineata*) in north west Europe.

Direct factors responsible for the movement and spread of pests and diseases include: the impact of higher temperatures on the number of pest generations per season, and increased humidity resulting in the enhanced incidence of fungal pathogens. Indirect factors include: changes in geographical production of host plants, and different cultivation practices as a consequence of climate change.

METHODS

The information presented in this paper is extracted from a broader study carried out by the authors in 2004, with contributions from expert climatologists and agronomists (Knight & Wimshurst, 2005). The main focus of the study relates to cropping patterns and pests, diseases and weeds in eastern and western Europe, and North America. The study involved literature research on the impact of climate change, and on the potential productivity of the main arable crops and on important pests (insects and nematodes), diseases and weeds. Estimated projections to 2020 were also made (with further comments on likely developments up to 2050) on changes in crop areas (due specifically to climatic factors rather than economic or social factors) and on the geographical development of important pests, diseases and weeds. The numeric projections are based on best estimates, with upper and lower limits (not based on mathematical modelling). The mid-range from the various Intergovernmental Panel on Climate Change (IPCC) scenarios was used. The general trends in climatic changes in Europe are for higher summer temperatures and wetter winters in northern latitudes, and for more extreme drought conditions in the south. A similar pattern is projected within North America. The baselines for the forecasts of crop areas are based on preliminary Food and Agriculture Organisation (FAO) data for 2004. Baseline pest, disease and weed infestation areas were derived from market research information produced by the agrochemical industry, complemented by a literature survey.

RESULTS

Projected trends for several pests, diseases and weeds are summarised in Table 1. Some pests, e.g. aphids (Aphididae), wireworms (*Agriotes* spp.) and soil nematodes, are projected to spread relatively little. Late potato blight (*Phytophthora infestans*) will follow host crops,

declining in southern Europe. Stem and leaf diseases of wheat will increase in incidence with milder winters in northern Europe, but will decline in the south. In wheat, grass weeds (e.g. slender foxtail (*Alopecurus myosuroides*) and wild oat (*Avena fatua*)) will show little change, other than where the crop moves north and declines in southern Europe. Examples of the mid-point projections of WCR infestation areas in maize are shown in Table 2.

Table 1. Outline trends in selected pests, diseases and weeds by 2020.

Species/crop	General trend	Europe	North America
Western corn rootworm in maize	Spreads with temperature rise	Extension from current outbreaks	Spreads to 50% of crop area
European corn borer (<i>Ostrinia nubilalis</i>) in maize	More generations; spreads north	Moves with crop	More frequent outbreaks
Colorado beetle in potato	Adaptable; moves north	Could become established in the UK and Scandinavia	More frequent in Canada
<i>Rhizomania</i> in sugar beet	Spreads with mild winters and hot summers	Potential for outbreaks throughout this region	Low incidence throughout this region
Grass weeds in maize (e.g. <i>Setaria</i> and <i>Echinochloa</i>)	Lower germination in dry areas, but greater in north	Spreads and move north with expanding crop area	Marginal increase with crop

Table 2. Estimated impact of climate change on western corn rootworm infestations in maize.

Region	Crop area (million ha)		Crop area infested (million ha)	
	2004	2020	2004	2020
Europe	15.1	18.1	< 0.1	2.1
North America	30.8	32.3	12.0	19.0

Projected trends to 2020 are expected to continue up to 2050 and beyond, and are useful strategic indicators for the plant breeding and crop protection industries.

REFERENCES

Knight B E A; Wimshurst A A (eds) (2005). Impact of climate on crop production and management - now and in the future. *Impact Reports - Multi-client study*, 202 pp.