Rothamsted Research Annual Report 2002-2003

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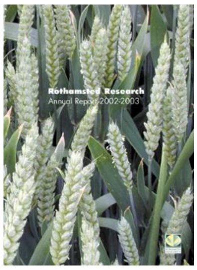

The Environmental Impact of Sugar Beet Production

Rothamsted Research

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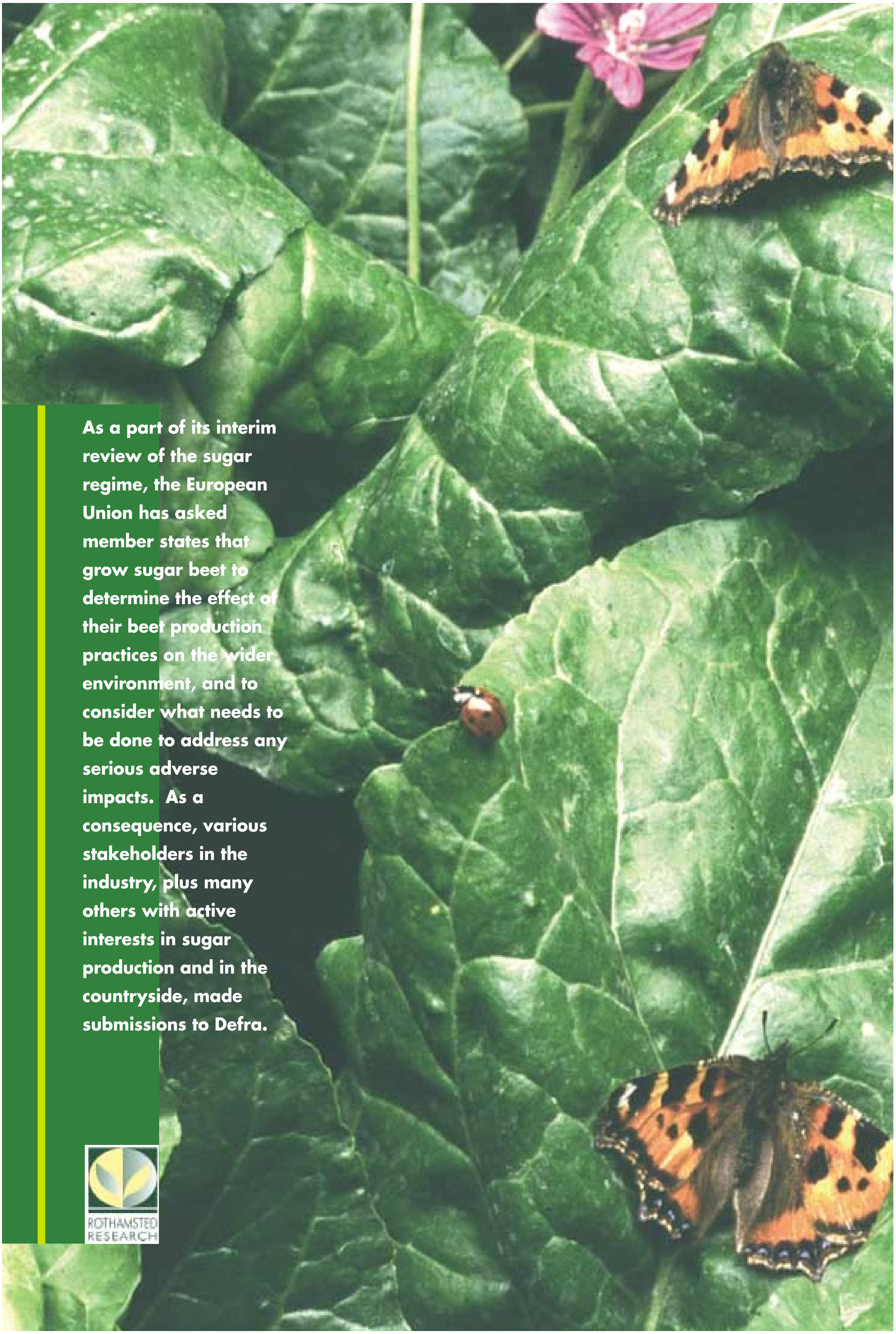
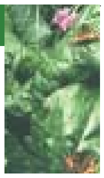


As a part of its interim review of the sugar regime, the European Union has asked member states that grow sugar beet to determine the effect of their beet production practices on the wider environment, and to consider what needs to be done to address any serious adverse impacts. As a consequence, various stakeholders in the industry, plus many others with active interests in sugar production and in the countryside, made submissions to Defra.

ROTHAMSTED RESEARCH



The environmental impact of sugar beet production in England

Keith Jaggard

Food production now needs a "licence to operate", and in response to this the British Beet Research Organisation funded a two year research project to assess the impact of sugar beet production practices in England on the natural environment. This project has involved collaboration between Broom's Barn and the Agriculture and Environment Research Unit at the University of Hertfordshire.

We started by describing thirteen distinct production protocols, which encompassed the major differences in practice for beet growing in England; these were based on data from the annual British Sugar crop survey. The production protocols varied according to soil texture, organic manure and irrigation use, wind erosion control practices, weed and pest control regimes and organic production. No protocol included practices which are not recommended or which contravene the pesticide and nitrate vulnerable zone regulations; the sugar company has a pesticide audit in place to ensure that these contraventions are minimized and that beet is not delivered in the event of serious accidental breaches.

We then assessed the impact of each of these production protocols in Suffolk, Lincolnshire and Shropshire, to represent the weather in the areas of the country where beet is grown, and the underlying geology. Many impacts of beet production practices depend upon the type of habitat surrounding fields. No previous large-scale survey has classified the boundary habitats for arable fields in England. In order to supply this data we visually assessed video images of two opposite boundaries on about 600 sugar beet fields. The video film was created in July 2001 during a nine hour aerial survey along transects chosen to represent the whole UK beet crop. The survey was flown at an altitude of about 200m, so boundary features were clearly visible. Analysis showed that about 65% of beet crop boundaries are hedges, about 9% are

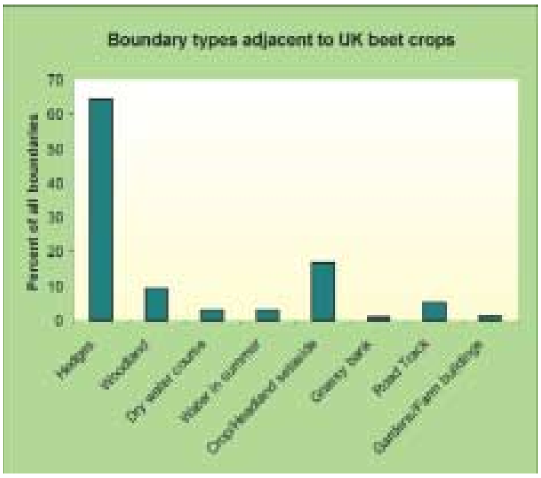


Figure 1. Types of vegetation in the boundaries of beet crops in the UK

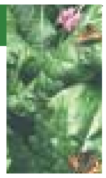
Variable growth in a beet field

Beet field with a cereal crop sown on the periphery

woodland or shelter belts and 17% are another crop or setaside, without any intervening natural vegetation (Figure 1). On average about 3% of the boundaries were ponds, streams or ditches which contained water at the time of the survey, but this differed significantly from region to region; from 7% in the Fens down to 1% in the remainder of eastern England.

The pesticide risk assessment software, p-EMA, identified no serious risks associated with beet production. However, there were several minor risks to indicator species, mostly with the persistent insecticides aldicarb and imidacloprid. Aldicarb has now been withdrawn and imidacloprid is applied as a seed treatment so that the exposure of non target species is minimal. Where surface water was present the most frequent risks were associated with herbicides, especially on the silty and peaty soils where the most sprays have to be applied to achieve effective weed control. There were no significant risks that agrochemicals would pollute ground water.

The fate of nitrogen was examined by simulating denitrification, volatalization, leaching and crop uptake using the Rothamsted SUNDIAL model, for a crop sequence of winter wheat, sugar beet and spring barley;



approximately 90% of all sugar beet follows a winter cereal crop. These simulations were made for all the soil textures on which beet is commonly grown, and for sequences of wet and dry seasons. Loss of nitrate during and after the growth of the beet was always negligible (less than 5kg ha^{-1}), but there were significant losses of N (up to 70kg ha^{-1}) by denitrification where organic manures were applied. If they can be devised, simple changes to farm practice to reduce these losses would be worthwhile.

The study also considered the energy input for all the production protocols. Consideration was given to raw material manufacture and transport, machinery manufacture, maintenance and fuel consumption, and to transport of beet to the processor. The total energy inputs ranged from 15 to 26 GJ/ha, and in common with other studies, those protocols which used little mineral N fertilizer consumed the least energy. The weighted average yield assumed for the production protocols was 52 adjusted tonnes/ha, and the energy yield, based on 16.9GJ t^{-1} of beet dry matter, averaged 202 GJ ha^{-1}, giving energy ratios which ranged between 8 and 13.5. These ratios are approximately double those that have been calculated for cereal production in NW Europe, and should make sugar beet a good candidate source for environmentally sustainable bioethanol production. A bonus would be the fact that beet is a spring sown crop (spring cropping provides a valued habitat for many species). The submissions to the EU on beet and the environment found that this was an important aspect now that 78% of all arable crops in eastern England are autumn sown.