

sugar beet with immunity to BNYVV would remove their concerns and allow infected land in East Anglia to be brought back into productive use. Also, the ability to move resistance genes into ideal agronomic backgrounds would speed up the breeding programme.

4. Insect Transmitted Viruses

4.1. Barley Yellow Dwarf Virus (BYDV)

BYDV infects all the small-grain cereals, along with maize and the majority of important pasture grasses. It has a worldwide distribution and is one of the most important plant-disease agents in the world. Actual losses due to BYDV in the United Kingdom are not known; but yield losses of 30–40% have been measured in field trials (unsprayed plots) (15), and up to 90% of crops can be affected in some years (16). Actual average losses in wheat and barley are probably in the region of 0.5–5%, which would represent a loss of about £10–100 million p.a., with epidemic years occurring once or twice in a decade. Losses of up to 26% have been reported for various ryegrass species (17).

BYDV belongs to the luteovirus group and is spread by aphid vectors in the persistent manner. There are 24 known species of aphid capable of transmitting BYDV; but only five species are thought to be significant vectors in the United Kingdom, with *R. padi* and *S. avenae* being the most important. At least three different strains of the virus occur in the United Kingdom, which differ in their vector specificity (18,19), virulence, and geographical distribution. The principal control measure for the virus in cereal crops in the United Kingdom is through the application of broad spectrum insecticides, particularly on winter cereals, though control using resistant or tolerant varieties is practiced outside Northwest Europe. BYDV is not usually controlled in pasture grasses in the United Kingdom, but some effort to breed more resistant varieties has been expended in the past (17). The epidemiology and control of BYDV in Britain has been reviewed by Plumb (20).

Progress in breeding for tolerance to BYDV in barley has been made using the *Yd2* gene, first identified in Ethiopian barley lines (21). The *Yd2* gene is now present in the new United Kingdom spring barley cultivar Amber. Older varieties, such as Coracle and Vixen, are also resistant to BYDV but are not grown widely since they are inferior to current cultivars and are particularly susceptible to *Rhynchosporium secalis*. Selection of resistant varieties is difficult owing to the lack of reproducible infection and variation in symptom expression. In addition to major genes, there are also nonspecific minor genes that have been accumulated in barley cultivars through many years of selection, which confer some tolerance to infection.

The wheat crop is attacked by a number of viruses, of which BYDV is the most important in the United Kingdom. However, wheat is generally not as