3. Case Studies

3.1. Viruses Transmitted by Soil Fungi

The most important of these are the viruses transmitted by the Plasmodiophorales. These viruses are transmitted inside the zoospores and resting spores of fungi such as *Polymyxa betae*. The long-lived nature of the resting spores of these fungi makes any control by crop rotations impossible. There is no viable chemical method for their control and breeding for resistance by conventional means is unsatisfactory.

There are two virus diseases of this type, which are of importance to UK agriculture, both discussed in detail below. These are the mosaic viruses of barley and rhizomania disease of sugar beet.

3.2. Barley Yellow Mosaic Virus and Barley Mild Mosaic Virus

Both barley yellow mosaic virus (BaYMV) and barley mild mosaic virus (BaMMV) cause a mosaic disease of winter barley in the UK ***(7)***. Both viruses are transmitted by the weakly parasitic root infecting fungus, *Polymyxa graminis*, whose resting spores can survive in soil for at least 10 yr. The spread of the disease is by soil movement, wind, water, or cultivation practices. It has been estimated that 13% of barley fields were infected by one or more of these viruses in 1988, and the disease is still spreading. Yield losses due to these two viruses are not precisely known, but losses of up to 30–50% have been reported from heavily infected areas. This could equate to a financial loss of about £14 million p.a. if these areas were uniformly infected. Some reduction of the virus disease can be seen if crops are sown later, especially if the disease is due to BaMMV ***(8)***. However, the planting of resistant varieties is the principal control method.

Conventional breeding for resistance to these viruses has resulted in the production of some resistant varieties of barley. A recessive gene, *ym4*, identified from a common parent, the Yugoslavian spring barley land-race Ragusa, confers resistance to both BaYMV and BaMMV. *Ym4* has been bred into such feed varieties of barley as Target, Epic, and Willow; but it is beginning to be seen in malting varieties too. There is also another source of tolerance to BaYMV and BaMMV in varieties such as Augusta, Sonja, and Sprite; but the genetic basis of the tolerance is not understood.

In the late 1980s, a resistance-breaking strain of BaYMV (BaYMV race 2) was found in Germany, France, and the United Kingdom that overcame the *ym4* resistance ***(9–11)***. Twenty-five separate outbreaks of the resistance-breaking isolate have been reported to date from a wide geographical area. Breeders are therefore now searching for other sources of resistance. There is genetic diversity for BaYMV and BaMMV resistance in barley landraces and varieties