50% were observed. Therefore it was assumed that these reductions were not only caused by BYDV but also by other pathogens. The high percentage of dead heads indicated that *Fusarium* could be one of these additional pathogens.

Hence, the winter wheat cvs 'Oretis' and 'Kraka', differing in susceptibility to *F culmorum* were used for investigations. The plants were sown at 2 different dates, in September and November, and were inoculated with BYDV in field trials at EC 25/23 and EC 55/65, but only once with *F culmorum* in EC 65. Virus strains used for this trials were PAV and MAV. Yield and growth of both cultivars after various inoculations with BYDV and *F culmorum* were compared with the untreated control.

When plants were inoculated with virus (PAV and MAV) at EC 25-35 yields were partly reduced to less than 50% whereas late inoculations at EC 55/65 reduced yield by only 30%. Inoculation with *F culmorum* caused a yield reduction to approximately 50%.

Combined inoculations of virus and fungus had a significantly more severe effect on wheat plants than only one of these pathogens. The yield was decreased to less than 20% of the healthy control. The synergistic effect of dual infection was clearly pronounced in wheat plants infected with both pathogens at nearly the same time. However, the early virus-inoculated plants (EC 25/35) did not show this synergistic effect to the same extent.

Concerning the various drill terms there was no remarkable distinct reaction to virus or combined inoculations. Only the inoculation with *F culmorum* was more effective in late-sown plants than in the early-sown ones.

In order to deduce the growth reduction of wheat after the various inoculations with BYDV and *F culmorum* the heights of the plants were measured. The results revealed the considerable effect of the early inoculations of BYDV at EC 25/35 with height reductions up to 20% in comparison to the untreated control whereas the height of plants which were inoculated at EC 55/65 was only reduced by 10% maximum. As there were no significant differences after the additional inoculation with *F culmorum* in comparison with plants which were only inoculated with virus the fungus had obviously no or a minor influence on growth reduction.

The results of these investigations confirmed the assumption that *F culmorum* was the most important contributing factor to the decreased yield of wheat during the serious epidemic of BYDV 1988 to 1990. Furthermore, from the results it can be concluded that BYDV infections obviously enhance the susceptibility of wheat plants to other pathogens.

There were significant differences in the behaviour of both cultivars tested.

Huth W (1990) Barley yellow dwarf – ein permanentes Problem für den Getreideanbau in Deutschland? *Nachrichtenbl Dtsch Pflanzenschutzdienst* 42, 33-39

Effect of successive BYDV inoculation times from October to April on the yield of some barley cultivars. S Steyer [1], F Froidmont [2] *([1] Station de phytopathologie, CRA, Gembloux; [2] Station d'amélioration des plantes, CRA, Gembloux, Belgium)*

In Belgium, barley yellow dwarf virus (BYDV) is present in some years in early-sown winter barley. Different strategies, such as the modification of sowing date or partial insecticide control, are used to avoid BYDV infection. However, none of these methods is completely satisfactory and the most effective control is probably plant tolerance or resistance. High levels of tolerance to BYDV in barley are conferred by the *yd2* gene, transferred from an Ethiopian landrace. This single, incompletely dominant, resistance gene is rather strong: it has been used commercially since 1967 without adaptation of isolates that could infect the resistant cultivars.

Artificial inoculation using viruliferous aphids is the only way to evaluate BYDV resistance or tolerance in cereals. As the PAV-strain is known to cause severe disease and to be efficiently transmitted by *Rhopalosiphum padi*, viruliferous aphids were transferred in the glasshouse to healthy seedlings of cv Clédor. In collaboration with the Plant Breeding Station, 9 cvs winter barley were studied (table I). Field plots were established in Gembloux, Belgium. The plots were 6 m long and 8 rows wide. Plants in a 1.5 m row section of each plot were infested at the 2-leaf stage on the 15 October and covered with a cage for 15 d. The cages were then shifted for 0.75 m, allowing the aphids to move under the cages to infect other plants, and the unprotected rows were treated with an insecticide. During the winter, the cages were removed and were then replaced at the beginning of March. The controls consisted of plants covered with cages without aphids and with healthy aphids for the cultivar Express. At the end of June, the rows were har-

Table I. Characteristics of the crosses used. Steyer and Froidmont.

7 268.004 and 7 267.004	(Vixen x Mosar) x Classica *yd2 ym1 ym1*
8 263.002 and 8 263.001	Mélusine x Vixen *ym1 yd2*
6 258.002	Vixen x Mosar *yd2* complementary genes
Nordic/Mielmont/Astrid and Express	

The first selection was made for the BaYMV; 7 268.004 and 7 267.004 are sister lines.

vested and the yield parameters were recorded for individual plants of each cultivar.

The average yield of the well-known varieties including Express and Nordic was reduced by BYDV infection by up to 0.1, compared with the control; these cultivars were even susceptible to a late infection (15 March) with viruliferous aphids. However, the lines under selection were already tolerant from the seedling growth.

Brome streak mosaic virus isolated from barley in south France. W Huth [1], DE Lesemann [1], R Götz, HJ Vetten [1], E Maiß [1], G Proeseler [2], P Signoret [3] *([1] Institut for Biochemistry and Plant Virology, Messeweg 11/12, D-38104 Braunschweig; [2] Institute for Epidemiology and Resistance, Theodor-Roemer-Weg 4, D-06449 Aschersleben, Germany; [3] INRA, 2, place Pierre-Viala, F-34060 Montpellier cedex, France)*

A potylike virus (11-Cal) was isolated from barley collected near Castelnaudary (southern France) and compared with some other rymo- and potyviruses. Using a crude plant extract, the virus was easily mechanically transmissible to barley, wheat and some other grasses. It is an unstable virus which lost the infectivity after lyophilisation or storage in a desiccator. *Aceria tulipae* has been found to be a natural vector of 11-Cal (Götz *et al,* 1995).

Isolate 11-Cal is serologically unrelated to wheat streak mosaic virus (WSMV) isolates from USA (WSMV-type), Russia, Iran and Italy. Isolate 11-Cal induced type II cytoplasmic cylindrical inclusions whereas those of WSMV isolates are clearly different being of types III or IV. Furthermore, 11-Cal is serologically related neither to the mite-transmitted *Agropyron* mosaic and ryegrass mosaic rymoviruses nor to the aphid-transmitted cocksfoot streak mosaic potyvirus. The coat protein sequences of 11-Cal and WSMV show a homology of about 50% (Huth *et al,* 1982).

Isolate 11-Cal is serologically closely related or identical to brome streak mosaic virus (BrSMV), which was first described in 1982 in Croatia (Milicic *et al,* 1982) as a pathogen of *Hordeum murinum* and *Bromus mollis* as well as to isolates supposed to be WSMV which have been isolated in the former German Democratic Republic (WSMV-Asl) (Rabenstein and Stanarius, 1981) and in France respectively. The molecular weights of the coat proteins (11-Cal *ca* 38 kDa; Asl *ca* 38 kDa) and the nucleic acids (3.2 x 10^6 kDa) of BrSMV, 11-Cal and WSMV-Asl differ from those of WSMV-type (*ca* 42 kDa and 2.8 x 10^6 kDa, respectively). Cells infected either by 11-Cal or by WSMV-Asl form morphologically identical inclusion bodies. Based on serological reactions and physico-chemical properties it is concluded that 11-Cal and the virus isolates formerly supposed to be WSMV are isolates of BrSMV.

BrSMV has mainly been found as pathogen of wild growing grasses (*H murinum* and *Bromus* spp). Only in France in several regions has BrSMV been found as pathogen of a cereal crop. In Germany 2 different sites are known where BrSMV occurs. At one site nearly 2 thirds of all *H murinum* plants were found to be infected by BrSMV but not any wheat plant on an immediately adjacent field. It is supposed that the virus is much more widerly spread than known today but since cereal plants rarely become infected it is mostly overlooked.

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