Turnip Yellows Virus in Winter Oilseed Rape

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Increasing levels of infection of winter oil seed rape by Beet western yellows virus were detected in different countries since the year 1985.

In Great Britain, yield trial plots of two cultivars with high levels of Beet western yellows virus infection resulted in 10 % and 26 % reduction in seed yield.

The investigations to determine the virus situation in winter oilseed rape fields were started at Aschersleben in the growing season 1990/91.

In this time one of the first question of the German oilseed breeders was to the identity of the Beet western yellows virus on oilseed rape. The background of the question was the opinion of the sugar Beet breeders and growers that the virus infecting winter oilseed rape is a great danger for the young sugar beet plants in the late spring/early summer, when viruliferous aphids from winter oilseed rape migrate to sugar beet fields in May and June. Therefore we have carried out transmission experiment with Beet western yellows virus from winter oilseed rape to plants of sugar beet and a lot of other species. In result of our experiment we could demonstrate, that the Beet western yellows virus from oilseed rape and other cruciferas are not able to infect sugar beet and represent in reality the Turnip yellows virus. Therefore we use again the correct name Turnip yellows virus for the Luteovirus of oilseed rape

Since the growing season 1995/1996 the virus situation was determined in co-operation with the plant protection service of some federal countries. In order to assess the situation of infestation in oilseed rape fields in late autumn or in spring leaf samples were picked up, mostly 50 leaves of each field, and tested in ELISA or direct tissue blot immunoassay (DTBIA) for virus infection.

For the determination of the economic importance of the virus plots of the cvs. Falcon and Zeus were inoculated with TuYV by artificial colonisation with viruliferous aphids of the species *Myzus persicae* in the end of September/beginning of October. The control plots were sprayed with a selective aphicide (pirimicarb).

RESULTS

Incidence of TuYV

Great differences in the degree of TuYV infections could be detected in the investigation period in Germany (Figure 1).





During the 1995/1996 growing season the degree of TuYV infection in samples from 181 fields of 198 fields tested from different parts of Germany ranged from 2 until 100 %. A very high infection degree was present especially in the northern, middle, western and eastern part of Germany. The samples from 147 fields of 152 fields tested of these regions were infected by the TuYV with an average of 71 % of the plants being infected. In contrast of them an average of infection degree from 14 % could be found in the southern federal countries.

No infection was detectable in samples from 93 fields of 121 fields tested in 1996/1997. The highest portions of TuYV infections, 15 to 23 %, could be found in samples of three fields only from the northern part of Germany.

Altogether samples of 263 rape seed fields were tested from all growing region in the 1997/1998 growing season. The degree of TuYV infections in samples from 58 fields of 132 fields tested from the middle and southern part of Germany ranged from 25 until 100 %, with an average of 60 % of the plants being infected. In contrast of them and to the results of the 1995/1996 growing season a low infection degree could be found in the samples of 130 fields from the eastern and northern part of Germany.

In 1998/99 the infestation situation was characterised on the one hand by a high infection degree especially of several fields in the northern growing region. On the other hand the occurrence of the TuYV in the southern part of Germany was low.

A similar infestation situation like in the growing season 1995/96 existed in 1999/2000.



Figure 2. Infestation by TuYV in winter oilseed rape fields detected in the 1999/2000 growing season

By the co-operation with the plant protection service of the most federal countries it was possible to determine the TuYV infection in 428 winter oilseed rape fields. Only 9 fields were virus free (Figure 2). 150 fields were infected by the TuYV from 76 to 100 % and further 73 fields from 51 to 75 %. The average infection degree for the last growing season in the northern, western, middle and eastern part of Germany was 62 %. The degree of TuYV infections in samples from fields tested from the southern part ranged from 0 until 90 %, with an average of 21 % of the plants being infected.

Our studies to the occurrence of TuYV on winter oilseed rape revealed two trends:

- **1.** From year to year great differences appear in the infection rates.
- 2. Great differences were detected between the growing regions.

Probably, the cause of the high degree of TuYV infection in oilseed rape in several years is its wide host range and the great number of aphid species which are able to transmit TuYV to oilseed rape plants. Under experimental conditions 17 of 24 tested aphid species are able to transmit the TuYV.

Symptoms of Turnip yellows virus on winter oilseed rape

After early infections by TuYV in September the first symptoms on oilseed rape were visible during late autumn as anthocyanous and/or red edge. During winter with mild weather conditions infected plants show conspicuous anthocyanous discoloration of the whole leaves. In spring the new leaves are without symptoms. Later in the spring and early summer and especially after period with high temperatures strong reddening are visible on many plants. Similar symptoms on winter oilseed rape may be caused by nutrition deficits, soil compaction and other abiotic reasons.

Yield losses

The results of yield assessment of the cultivars Falcon and Zeus infected by TuYV carried out for three years showed significant reductions in seed yield. Whereas in 1993 both cvs. yielded 12% less seed, seed yields of Falcon and Zeus were reduced by 19% and 34%, respectively in 1994 when compared to virus-free plots (Figure 3). In the third year the yield was reduced by 18 until 28%. The average reduction in seed yield of the three years was 20% what is about equivalent of 0.8 tons per hectare.



Figure 3.Yield losses of oilseed rape induced by TuYV infections in plot trials

Similar like the experiments in Great Britain our yield trials gave a clear reduction of the seed yield by virus infection.

On the basis of the high attack of oilseed rape fields in most growing regions of Germany and the distinct yield losses determined in field experiments it can be concluded that it is necessary to control the infestation of oilseed rape by TuYV.

The best way to prevent yield losses caused by virus infection in oilseed rape is the breeding and growing of virus resistant cultivars.

In glasshouse and field experiments genotypes of summer and winter oilseed rape cultivars, actual breeding lines and resynthesized rape forms, were screened for resistance to TuYV. All of the rapeseed genotypes were susceptible to TuYV. An exception was only the resynthesized rapeseed R 54 from the University of Göttingen, from which single plants were selected resistant to TuYV. In 1994 the R 54 was used for cross experiments to transfer the TuYV resistance in winter oilseed rape cultivars and breeding lines.

In the following I want to present some of the results of our field experiments.

At the end of September the plots of single plant progenies was artificial inoculated with TuYV by colonisation with viruliferous *Myzus persicae*. Several cultivars which showed very high degree of susceptibility to TuYV in former experiments was used as susceptible control.

In late autumn and early spring virus infections were assessed by means of DAS-ELISA. using a polyclonal TuYV antiserum produced in co-operation with Mr. Rabenstein, Aschersleben. The results of DAS-ELISA from the progenies were compared with the results of the highly susceptible cultivars.

We have divided the plants according their absorbance values into three groups:

- <u>absorbance values <0.1</u>: These plants can be considered as virus free and, consequently, as extremely resistant.
- <u>absorbance values = 0.1 to 0.6</u>: Plants that contain reduced amounts of virus. They can be considered as resistant.
- <u>absorbance values > 0.6</u>: Plants of cultivars, used as susceptible controls, all belonging to group 3, never showed reduced absorbance values as found for resistant progenies.

Using a RT-IC-PCR technique developed by Dr. J. Schubert, Aschersleben, apparently virus free plants were tested to confirm that they were really free of virus.

RESULTS

In field experiments 487 progenies of crosses between winter oilseed rape and R54 were tested for resistance by means of artificial colonisation with infectious aphids.

436 populations proved to be resistant to infections by TuYV (Figure 4). Among them 121 populations could be identified where not any single plants tested by DAS-ELISA showed positive reactions for virus content.



Figure 4. Percentage of ELISA values of several progenies after TuYV inoculation in field experiments

This means these populations show stable resistance to TuYV in early stages of plant development in form of a limited virus spread. Among further 105 populations only a limited number of plants with low virus titer was detected.

A further improvement of detection sensitivity was achieved by application of immunocapture-reverse transcriptase-PCR (IC-RT-PCR). Several plants found to be free of virus as shown by DAS- and amplification-ELISA proved to be free of virus if this highly sensitive method was used (Figure 5). This seems to be a case of extreme TuYV-resistance.



Figure 5. Comparison of the results of amplification-ELISA and IC-RT-PCR with samples from plants of resistant F6

SUMMARY

The investigations resulted TuYV-resistant plants in different proportion in the progenies.

Whereas in field experiments clear virus symptoms were visible on the susceptible cvs. from autumn until early spring and newly appeared in early summer, plants of the resistance source R 54 and progenies from crosses with it remained without symptoms of virus infection over the whole period.

By means of DAS-ELISA no virus infection were detectable in the most plants of several populations. Furthermore, the virus concentration in the progenies were distinctly decreased and virus symptoms were not visible, indicating that these progenies were virus resistant, too. Using a IC-RT-PCR technique it was possible to show that plants selected from different

generations of selfing to generate extreme virus resistant basic material were extreme resistant.

The successful transfer of TuYV resistance in susceptible oilseed rape cultivars and breeding lines showed that it will be possible to prevent virus induced yield losses by virus resistant cultivars in future.