

Infestation of winter oilseed rape by Turnip yellows luteovirus and its relevance to yield

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Abstract

The Turnip yellows luteovirus (TuYV) is transmitted by several aphid species and causes considerable yield losses in Germany and other European countries. Winter oilseed rape fields are often highly or totally infected by TuYV and all important winter oilseed rape cultivars currently available are susceptible to TuYV. In 2001/2002 a field test was carried out at 10 locations in order to investigate the effect of TuYV on grain yield. The average yield loss by artificial TuYV-infestation amounted to 0.49 t/ha corresponding to 14.2 %. Yield losses due to TuYV infection were significant at $\alpha = 0.05$ for cvs. 'Express', 'Fortis' and 'Prince'. On average the highest yield loss (22.4 %) was estimated on cv. 'Prince'.

Key Words: *Brassica napus* – Turnip yellows luteovirus (TuYV) - DAS-ELISA – yield losses

Introduction

The Turnip yellows virus (TuYV, *syn. Beet western yellows virus*, BWYV) is a member of the economical important luteovirus group. It is transmitted by several aphid species in a persistent manner. TuYV can infect many wild and crop plant species for instance cabbage (*Brassica oleracea*), turnip rape (*Brassica rapa ssp. oleifera*) and oilseed rape (*Brassica napus* L. var. *napus*), bean (*Vicia faba*) and pea (*Pisum sativum*) (Graichen, 1999).

Symptoms of TuYV are red discolorations and red leaf margins in autumn. At flowering the lower leaves show yellow and red discolorations and the plants in general exhibit growth reduction (Graichen, 1999). TuYV is an important disease in Germany as winter oilseed rape fields are often highly or totally infected. For instance in 1999/2000 the infestation degree amounted to 69 % on average of seven states of the Federal Republic of Germany and yield losses ranged from 12 % to 34 % (Smith and Hinckes, 1985; Graichen, 1997; Graichen, 1999). Besides this, TuYV is widespread in other European countries and different parts of the world as well.

In the frame of an environmentally friendly rapeseed production for human nutrition and as renewable resources a high level of disease resistance is needed. Therefore, in order to get detailed information on yield losses caused by TuYV a field test was carried out in 2001/2002.

Material and methods

Field tests with the same experimental design were carried out at 10 locations in different geographical regions of Germany in co-operation with five private breeding companies. Locations ranged from Hesse to Schleswig-Holstein. Field tests were carried out in a block design with three replications. Size of the plots differed on the various locations between 11.2 m² to 19.5 m². The aim of this study was to determine yield losses caused by TuYV by comparing yields of four

currently important cultivars, i.e., 'Express', 'Fortis', 'Mohican', and 'Prince' in a healthy control variant and by artificial TuYV-infection.

The healthy control was treated with insecticide three times in September/October in order to control aphids. The other variant was inoculated with TuYV carrying aphids (infected variant) in the second part of September or first part of October. The aphids (*Myzus persicae*) were propagated on winter oilseed rape plants infected with the TuYV isolate BN5ASL. For each plot two leaves with many aphids (*Myzus persicae*) were used for artificial inoculation. The aphids were applied to the test plants with a soft brush.

The sampling for ELISA took place 6 to 8 weeks after inoculation in November/December taking one leaf from 15 different plants equally distributed along the plot. The samples were investigated by Double Antibody Sandwich-Enzyme Linked Immunosorbent Assay (DAS-ELISA) using polyclonal antibodies prepared in the Institute of Resistance Research and Pathogen-diagnostics in Aschersleben. The measured extinction ($E_{405\text{ nm}}$) gives information about resistance ($E_{405\text{ nm}} < 0.1$) or susceptibility ($E_{405\text{ nm}} > 0.1$).

Statistical analysis was carried out by variance analysis and F-test. Significance of differences were investigated by Least Squares Means (program SAS.6).

Results

Extinction of all cultivars in the infected variant is high ($E_{405\text{ nm}} > 1.0$, Fig. 1) while lower extinction values were found in the control. The occurrence of TuYV in the control is caused by an insufficient effect of the insecticide treatment for instance caused by rain fall after treatment or by high natural infestation at some locations. In the infected variant only small differences in the extinction between cultivars was observed. The extinction of the cultivar „Prince“ is a little higher ($E_{405\text{ nm}} = 1.37$) than of the others ($E_{405\text{ nm}}$ about 1.1). However, it turned out that all of these cultivars are susceptible to TuYV (Fig. 1).

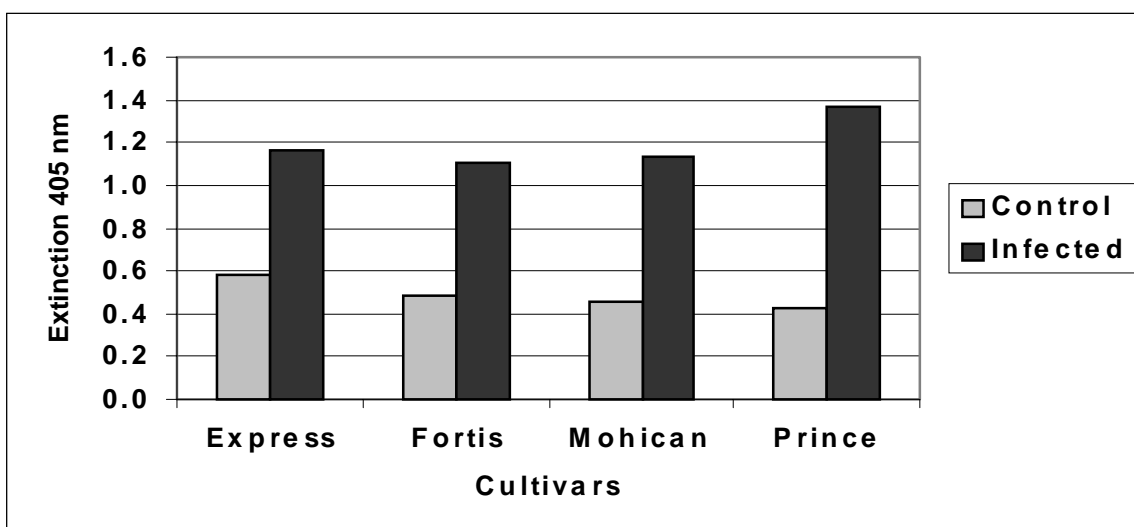


Fig. 1: Extinction $E_{405\text{ nm}}$ of winter oilseed rape cultivars on average of 10 locations in November 2001

On average of these cultivars yield reduction due to TuYV infection was estimated at 14.2 % ranging from minimum 7.2 % ('Mohican') to maximum 22.4 % ('Prince'). At some locations maximum significant yield losses larger than 30 % were observed. The absolute yield loss on average amounts to 0.49 t/ha (Fig. 2). Yield losses ranged from 0.24 t/ha ('Mohican') to 0.83 t/ha ('Prince'). Maximum yield losses were estimated up to 1.6 t/ha at some locations. The yield losses of all cultivars were significant at $\alpha = 0,05$ with exception of cultivar 'Mohican'. Figure 2 shows the grain yield on average of 10 locations in the control and infected variant.

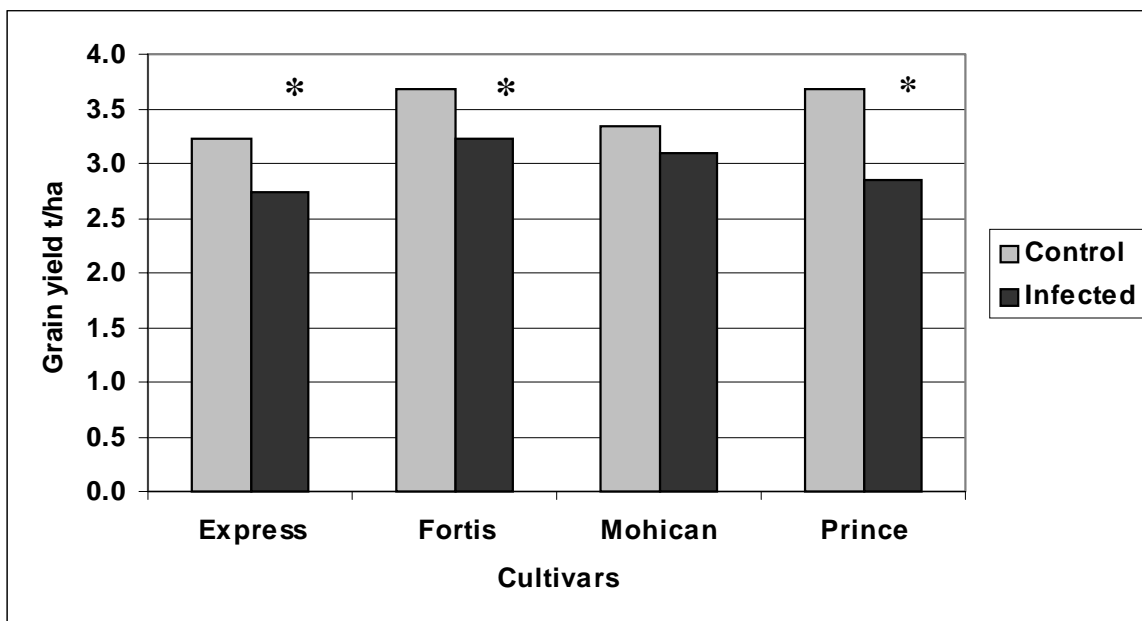


Fig. 2: Grain yield of winter oilseed rape cultivars (average of 10 locations) in July 2002 in a healthy control and after artificial TuYV infection, * significant $\alpha = 0.05$

Discussion

All currently important winter oilseed rape cultivars are susceptible to TuYV. The yield losses caused by TuYV (average 14.2 %) are considerable. There are differences in susceptibility of the cultivars. Yield losses were maximum by cultivar 'Prince' (average 22.4 %). On some locations yield losses of single cultivars amounted to more than 30 % giving hint that the virus infestation has different effects on yield on various locations. The results of the field tests confirm the results of former investigations on yield losses by TuYV between 12 % and 34 % (Smith and Hinckes, 1985; Graichen, 1997). In the current field tests the average yield loss was lower in comparison to 20.4% observed in triannual field tests in Aschersleben on cultivars 'Falcon' and 'Zeus' (Graichen, 1997). Nevertheless, recent results have proven that TuYV has to be considered as an economical important disease of winter oilseed rape. Breeding for resistance is of special importance therefore, especially as it turned out that even by insecticide treatment the virus was not fully controlled as some virus has been detected even after insecticide treatment (Fig. 1).

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References

- Graichen, K., 1997: Wasserrübenvergilbungsvirus. Ertrags- und Qualitätsminderungen beim Winterraps. Raps 15 (4), 156-158
- Graichen, K., 1999: Häufig verkannt: Die Wasserrübenvergilbung an Winterraps. – Der Pflanzenarzt 9-10, 8-10
- Smith, H.G. and Hinckes, J. A., 1985: Studies on beet western yellows virus in oilseed rape (*Brassica napus* ssp. *oleifera*) and sugar beet (*Beta vulgaris*). Annals of Applied Biology 107, 473-484