Turnip yellows luteovirus resistance in winter oilseed rape

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Abstract

As a result of an extensive screening program resistance to Turnip yellows luteovirus (TuYV) could be found only in the resynthesized rapeseed R54. Resistance to TuYV of R54 has been transfered already into current oilseed winterrape cultivars and breeding lines by crossing. In 2001/2002 a field test was carried out in order to compare yield of four susceptible cultivars (standards) and twelve resistant breeding lines in a healthy control and an artificially TuYV infected variant. The resistant breeding lines on average had low virus contents (average extinction $E_{405\ nm}$ = 0.26) in comparison to released cultivars. Although these lines express a high level of resistance they are lower yielding than released susceptible cultivars. The resistant breeding lines yielded on average 76.4 % in the healthy control and 87.4 % in the variant with artificial virus infection in relation to the yield of the susceptible standards. However, trials revealed that some breeding lines are already higher yielding than released cultivars in the infected variant.

Key words: *Brassica napus* – Turnip yellows luteovirus (TuYV) – virus resistance – breeding lines – DAS-ELISA – grain yield

Introduction

All winter oilseed rape cultivars are susceptible to TuYV. This may be due to the high level of susceptibility within cabbage (*Brassica oleracea*) and turnip rape (*Brassica rapa* ssp. *oleifera*), because out of a total of 652 genotypes of oilseed rape and resynthesized rape forms screened for resistance to TuYV only the resynthesized rapeseed R54 developed at the University of Göttingen turned out to be resistant against TuYV. R54 is derived from a cross of white cabbage (*Brassica oleracea* var. *capitata* f. *alba*) and chinese cabbage (*Brasssica rapa* ssp. *pekinensis*). The donor of resistance is the chinese cabbage (Graichen, 1994). A breeding program was started to transfer resistance into adapted breeding lines. In 2001/2002 a field test was carried out in order to compare yield of four susceptible cultivars (standards) and twelve resistant breeding lines in a healthy control and by artificial TuYV-infection.

Material and methods

Field tests with the same experimental design were carried out at the Federal Centre of Breeding Research on Cultivated Plants at Aschersleben (one location) and at five breeding companies (mostly two locations) in different parts of Germany. The aim was to compare yield of four released cultivars (standards: ´Express´, ´Fortis´, ´Mohican´, ´Prince´), which are susceptible and twelve resistant breeding lines in a healthy control and by artificial TuYV-infection. Each breeding company used their own resistant breeding lines at both locations. Material and methods of the field trail are described by Paetsch, 2003 (this issue).

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 provided by the Institute of Resistance Research and Pathogen-diagnostics in Aschersleben. The measured extinction $E_{405\ nm}$ gives information about resistance ($E_{405\ nm} < 0.1$) or susceptibility ($E_{405\ nm} > 0.1$).

Results

Comparison of extinction $E_{405\ nm}$ between standards and lines elucidates the high level of resistance present in breeding lines. The extinction $E_{405\ nm}$ of resistant breeding lines was nearly the same in the control and the artificially infected variant (average extinction $E_{405nm} = 0.26$). Resistant breeding lines had considerable lower extinction $E_{405\ nm}$ than the susceptible standards (Fig. 1).

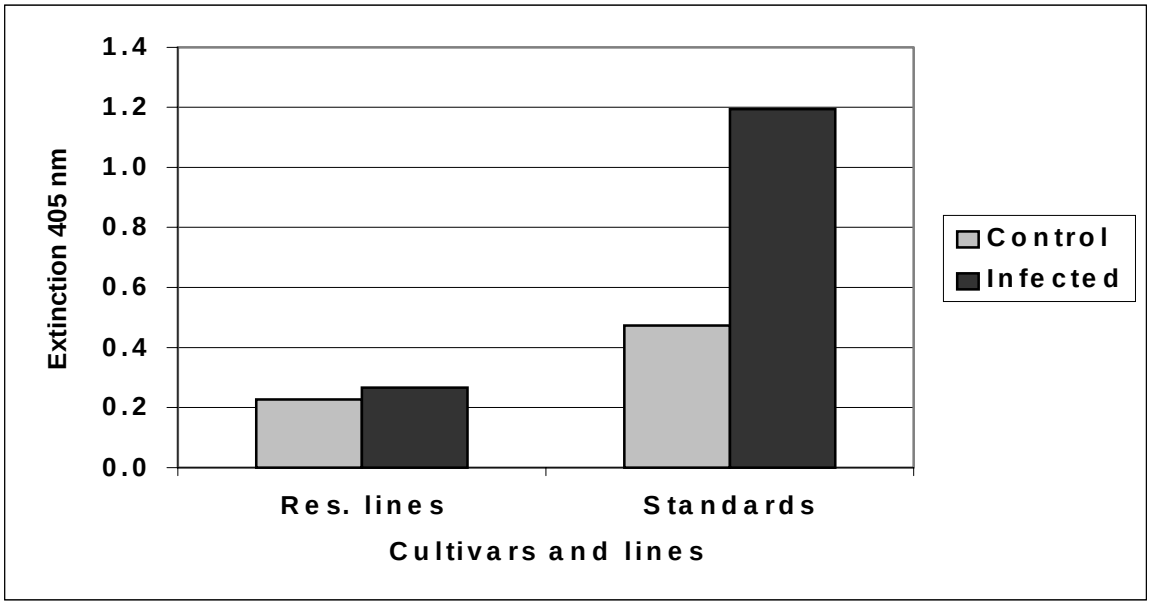

Fig. 1: Extinction $E_{405\ nm}$ of TuYV resistant breeding lines and susceptible standards in the control and artificial infected variant on average of 10 locations, November 2001

The level of resistance to TuYV of the breeding lines is already high, but the yield ability is on average still low as compared to standard cultivars. In relation to the susceptible standards, resistant lines yielded on average 76.4 % in the healthy control and 87.4 % in the artificially inoculated variant. However, looking at single lines it turned out that in the infected variant some breeding lines already out-yielded released cultivars.

The yield losses of the standards in the infected variant compared to the healthy control were considerable (about 20 %) in Teendorf (Fig. 2). In contrast, no yield losses were observed in resistant lines with the exception of RL_5. In Teendorf the resistant lines yielded on average 112.2 % after artificial inoculation with a maximum relative yield of 131.4 %. At this location 10 out of 12 resistant breeding lines had an higher yield than the susceptible standards in the infected variant. Yield of the resistant lines at this location was on average 0.89 t/ha higher than of released cultivars (data not shown) giving hint that to some extend resistance has been combined with good agronomical performance already at least under high infection pressure.

The extinction $E_{405\ nm}$ of all breeding lines was lower than of the standard cultivars (Fig.2). While some lines were completely resistant ($E_{405\ nm} < 0.1$) virus was detected in others ($E_{405\ nm}$ about 0.2 to 0.9), but relative grain yield of these lines was still high giving hint that besides resistance tolerance exists.

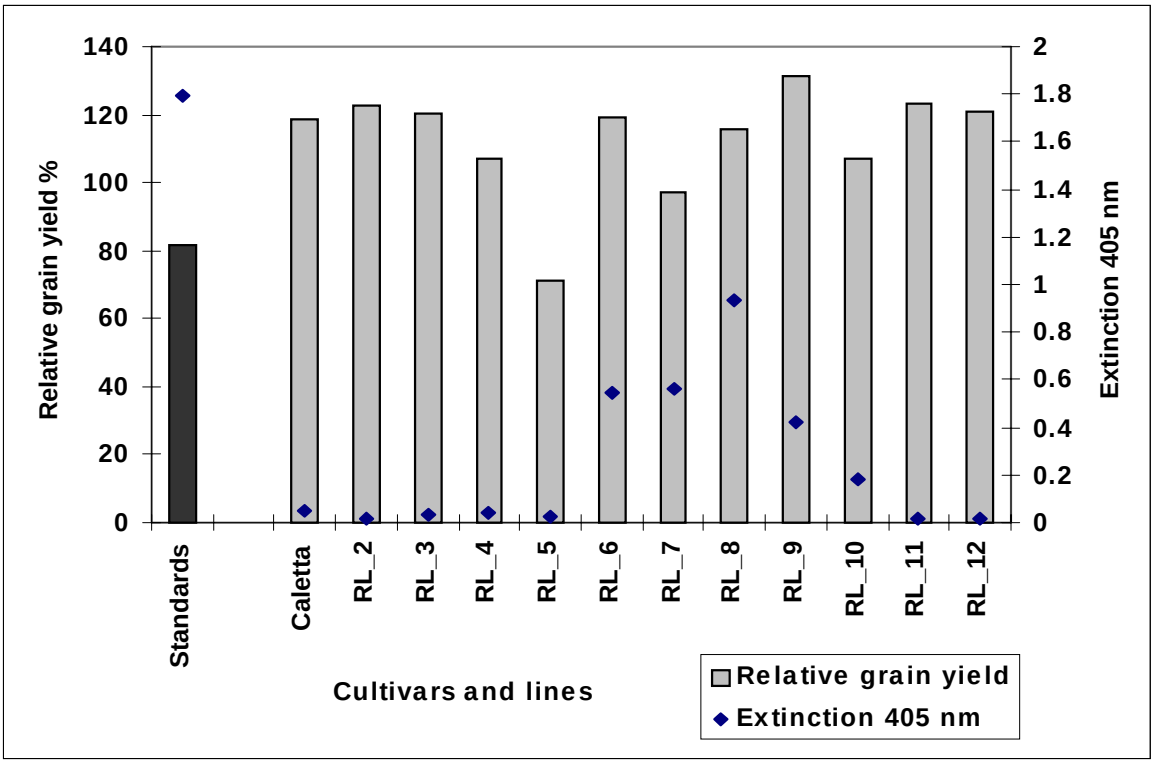

Fig. 2: Relative grain yield and extinction $E_{405\ nm}$ of standards (average about 4 susceptible cultivars), resistant cultivar ´Caletta´ and resistant breeding lines (RL) of the infected variant in proportion to the healthy control (Teendorf, Saatzucht Hadmersleben GmbH)

Discussion

The results elucidate that to some extend resistance of R54 to TuYV has already been combined with good agronomic performance, although these lines are still in general inferior to released cultivars in the absence of TuYV. However, these lines will be improved by future breeding attempts being the basis for an environmentally friendly rapeseed production as resistance has to be considered as the most cost effective kind of plant production avoiding prophylactic spraying of insecticides. Future breeding programmes may be enhanced by the use of molecular markers (Dreyer et al., 2001).

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