

# Resistance evaluation of oilseed rape cultivars and germplasms to Turnip mosaic virus

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## Abstract

Resistance of twenty-seven cultivars and germplasms of oilseed rape (*Brassica napus* L.) to Turnip mosaic virus (TuMV) were evaluated by artificial inoculation. 13 *B. napus* cultivars, some of which are currently applied in oilseed rape production, were all susceptible to TuMV. However, their disease indexes were lower than control cultivar Zhongyou 821. Among 14 germplasms of oilseed rape tested, 3 showed high or medium resistance to TuMV. The results indicated that the tested cultivars of oilseed rape could not resist to TuMV under high TuMV disease pressure.

**Key words:** resistance evaluation, turnip mosaic virus, oilseed rape

## Introduction

Viral disease is one of the major diseases in *Brassica napus* and widely distributed in oilseed rape production areas in China. The viral disease causes around 10% yield loss of oilseed rape when it is in the disease epidemic years. Turnip mosaic virus (TuMV), Cucumber mosaic virus (CMV) and Oilseed rape mosaic virus (ORMV) are the three viruses naturally infecting oilseed rape in China. Among them, TuMV is most economically important and over 80% viral diseased sample collected from fields was identified as TuMV infection (Li, 1996).

Application of resistance cultivar is the most economic and efficient mean for management of viral disease. Some resistance resources to TuMV were obtained from large-scale screening of germplasms of oilseed rape in 1980's and used in oilseed rape resistance breeding program (Li et al., 1992). Several resistant varieties to TuMV were produced and have been applied in oilseed rape production in China, which plays an important role for reducing the yield loss caused by TuMV. Because of breeding technology development, many double-low (low glucosinolate content and low erucic acid) and hybrid varieties of oilseed rape have been produced and commercialized in recent years in China. We evaluated these cultivars and some germplasms for resistance to TuMV by mechanical inoculation in this report.

## Material and Methods

13 cultivars and 14 germplasms of oilseed rape (*Brassica napus*) tested in this study were provided by Oil Crops Research Institute of Chinese Academy of Agricultural Sciences and Huazhong Agricultural University. Cultivar Zhongyou 821 was used as a control. Some of these cultivars are currently applied in oilseed rape production in China. 16 TuMV isolates were selected as inoculums in this study. Their host plants and geographical locations were listed in table 1.

The experiments were carried out in an insect proof screen-house in 2004. 10–15 plants of each cultivar or germplasm of oilseed rape were mechanically inoculated with certain TuMV isolates at seedling stage. The TuMV-diseased leaves of oilseed rape was ground in inoculation buffer (0.07 M potassium phosphate containing 0.02 M mercaptoethanol, pH 7.0) as inoculum. Inoculated plants were kept in the screen-house one month for observation of symptom development. The disease index was calculated according to disease incidence and severity to TuMV isolate infection. The resistance evaluation of each cultivar or germplasm was according to average disease index (ADI) with all TuMV isolates tested. The resistance (susceptible) rank is classified into 5 rates based on ADI, including immune: 0; high resistance: 0.1–10.0; medium resistance: 10.1–30.0; medium susceptible: 30.1–50; high susceptible: over 50.

**Table 1** The host plants and locations of 16 TuMV isolates used in this study

Isolates	Locations	Host plant	Isolates	Location	Host plant
Wh2	Wuhan, Hubei	<i>B. rapa</i>	Mc5	Macheng, Hubei	<i>B. napus</i>
Wh4	Wuhan, Hubei	<i>B. napus</i>	Ym1	Macheng, Hubei	<i>B. rapa</i>
Wh5	Wuhan, Hubei	<i>B. napus</i>	Ym3	Yunmeng, Hubei	<i>B. napus</i>
Wh9	Wuhan, Hubei	<i>B. napus</i>	Tp3	Taiping, Anhui	<i>B. napus</i>
Wh10	Wuhan, Hubei	<i>B. napus</i>	Sx1	Gaoshantang, Anhui	<i>B. napus</i>
Mc2	Macheng, Hubei	<i>B. rapa</i>	Sx2	Gaoshantang, Anhui	<i>B. napus</i>
Mc3	Macheng, Hubei	<i>B. campestris</i>	Sx4	Shengdu, Anhui	<i>B. napus</i>
Mc4	Macheng, Hubei	<i>B. napus</i>	Mas1	Maanshan, Anhui	<i>B. napus</i>

## Results

### 1. Resistance evaluation of 13 *B.napus* cultivars to TuMV

The average disease index of 13 *B.napus* cultivars and Zhongyou 821 to five TuMV isolates was listed in table 2. These 13 cultivars were all susceptible to TuMV when they were inoculated with TuMV isolate Wh2, Mc5, Ym3, Tp3 and Mas1, respectively. The diseased plants showed wide range symptoms, such as mosaic, necroses on leaves and severely stunt. However, the susceptible differences were observed among 13 cultivars. According to the average disease index to 5 TuMV isolates infection, 5 cultivars showed medium susceptible, other 8 cultivars showed high susceptible. The difference of disease index was existed when same cultivar was inoculated with different 5 TuMV isolates, which indicated these five TuMV isolates had variability in virulence. It was also revealed that “double low” cultivars of *B.napus* had lower disease index than hybrid cultivars had. The disease index of Zhongshuang 4, Suyou 1 and Zhongshuang 6 were significance lower than the control cultivar Zhongyou 821.

Four cultivars: Zhongshuang 4, Zhongyouza 1, Zhongyouza 2 and Huashuang 3 were tested their resistance to TuMV by inoculation with another 11 TuMV isolates (Wh4, Wh5, Wh9, Wh10, Ym1, Mc3, Mc4, Sx1, Sx2, Sx4, Tp2) in the spring, 2004. Their susceptible ranks were similar as that obtained in table 2. Zhongshuang 4 and Huashuang 3 had the lowest and highest average disease index among these four cultivars, respectively (Table 3).

### 2. Resistance evaluation of 14 germplasms to TuMV

The reactions of 14 oilseed rape germplasms to 2 TuMV isolates (TuMV-Wh4, TuMV-Mc3) infection were listed in table 4. The differences of resistance to TuMV were found among these germplasms tested. The no. 001495 showed high resistance to TuMV. Its average disease incidence and disease index was 14.3% and 7.2, respectively and only mild mosaic was observed on leaves of infected plants. Other two germplasms no.003212 and no.001471 showed medium resistance to TuMV. However, no. 002705 showed high susceptible to TuMV. Its disease incidence and disease index reached 100% and 95.9, respectively, and infected plants showed necrosis on leaves and the plants were severely stunt. It was found that the germplasms in *B.campestris* or *B. juncea* types had higher resistance to TuMV than the germplasms in *B.napus* type had.

**Table 2 Reactions of 13 *B.napus* cultivars to 5 TuMV isolates by sap inoculation ( Autumn, 2004)**

Cultivars	Average disease incidence (%)	Average disease index	Resistance rank	Significant level	
				5%	1%
Zhongshuang 4	61.1	30.1 (17.5–46.0)	MS	a	A
Suyou 1	65.8	30.2 (15.0–47.2)	MS	a	AB
Zhongshuang 6	59.8	32.7 (13.9–46.7)	MS	a	AB
Ningyou 12	63.7	34.2 (16.7–53.6)	MS	a	ABC
Zhongshuang 7	77.3	39.7 (32.8–50.0)	MS	ab	ABC
Zhongshuang 9	69.8	41.0 (33.8–51.2)	MS	ab	ABC
Huashuang 4	80.6	42.6 (29.7–65.4)	MS	ab	ABC
Zhongyouza 1	68.3	46.3 (22.2–75.0)	MS	ab	ABC
Zhongyouza 2	83.3	49.5 (37.5–64.6)	MS	ab	ABC
Huaza 8	84.4	50.6 (37.8–59.5)	HS	ab	ABC
Zhongyouza 3	78.4	53.8 (36.4–70.0)	HS	bc	ABC
Huaza 6	75.8	57.0 (46.2–72.6)	HS	bc	ABC
Huashuang 3	92.8	60.8 (41.7–87.5)	HS	bc	BC
Zhongyou 821	86.6	60.8 (41.7–87.5)	HS	c	C

Note: In the parenthesis is the range of disease index.

**Table 3 Reactions of 4 *B.napus* cultivars to 11 TuMV isolates by sap inoculation (Spring, 2004)**

Cultivars	Average disease incidence (%)	Average disease index	Significance level (5%)
Zhongshuang 4	82.2 (46.7–100)	36.6 (15.0–61.7)	a
Zhongyouza 1	76.7 (40.0–100)	45.9 (10.0–86.1)	ab
Zhongyouza 2	88.9 (56.3–100)	46.4 (25.0–86.5)	ab
Huashuang 3	95.3 (78.6–100)	58.6 (28.6–91.1)	b

Note: In the parenthesis is the range of disease incidence and disease index, respectively.

## Discussion

National-wide cultivars screening for resistance to TuMV was carried out in China in 1980's. Of total 264 cultivars with *B.napus* or *B.campestris* tested, 7.1% *B.napus* cultivars were high resistance to TuMV. Only 20% *B.napus* cultivars were high susceptible to TuMV, compared with 96.2% for *B.campestris* cultivars (Zhou et al., 1990). This result indicated the *B.napus* cultivars had higher field resistance to TuMV than traditional *B.campestris* cultivars's did. One of example, Zhongyou 821, a commercialized *B.napus* cultivar during 1980's in China, performed high resistance to TuMV in field condition, and has been employed as a resistance control for long period (He et al., 1987).

Many new-bred *B.napus* cultivars are being used in oilseed rape production in recent years. Some cultivars, such as Zhongyouza 2, Zhongshuang 6, Zhongshuang 7, and Zhongshuang 9 etc, performed higher resistance to TuMV than Zhongyou 821 in field conditions. However, these cultivars were all high susceptible to TuMV when they were mechanically inoculated with TuMV. It may be caused serious yield losses in the condition of high TuMV disease pressure. 3 of 14 germplasms showed resistance to TuMV in high pressure of TuMV inoculum. The resistance of these three genotypes was conformed by repeat inoculation. Whether these resistance resources can be used in oilseed rape resistance breeding, it need be

further study.

**Table 4 Reactions of 14 oilseed rape genotypes to 2 TuMV isolates by sap inoculation (Spring, 2004)**

Rank	National		Type	Average disease incidence (%)	Average disease index	Resistance rank
	code					
1	001495		<i>B.campestris</i>	14.3 (0.0~28.6)	7.2 (0.0~14.3)	HR
2	003212		<i>B.juncea</i>	57.2 (14.3~100)	24.7 (3.6~45.8)	MR
3	001471		<i>B.campestris</i>	58.4 (50.0~66.7)	27.1 (20.8~33.3)	MR
4	003209		<i>B.juncea</i>	75.5 (50.0~100)	31.3 (25.0~37.5)	MS
5	003215		<i>B.juncea</i>	87.5 (71.4~100)	35.4 (35.0~35.7)	MS
6	001460		<i>B.campestris</i>	83.4 (66.7~100)	37.5 (25.0~50.0)	MS
7	003207		<i>B.juncea</i>	70.0 (60.0~80.0)	47.5 (35.0~60.0)	MS
8	003210		<i>B.juncea</i>	83.4 (66.7~100)	50.0 (29.2~70.8)	MS
9	003307		<i>B.napus</i>	100	53.6 (50.0~57.1)	HS
10	003315		<i>B.napus</i>	100	53.9 (53.6~54.2)	HS
11	003208		<i>B.juncea</i>	91.7 (83.3~100)	54.2 (33.3~75.0)	HS
12	003205		<i>B.juncea</i>	92.9 (85.7~100)	61.8 (53.6~70.0)	HS
13	003367		<i>B.napus</i>	92.9 (85.7~100)	63.7 (60.7~66.7)	HS
14	002705		<i>B.napus</i>	100	95.9 (91.7~100)	HS

Note: In the parenthesis is the range of disease incidence and disease index, respectively.

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