

Agronomic performance of tobacco breeding lines carrying black root rot resistance

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ABSTRACT

Chalara elegans is a cool climate parasite of many cultivated and wild growing plants world-wide including tobacco. The fungus causes necrotic lesions on roots that reduce the yield and quality of leaves. One of interesting sources of black root rot resistant germplasm is wild relative of tobacco *N. glauca*. Interspecific hybrids of *N. tabacum* cv. Wiślica x *N. glauca* (WGL) were previously produced to transfer *N. glauca* resistance genes into tobacco. In this study ten breeding lines of BC₂F₅– BC₂F₇ generation carrying black root rot resistance were evaluated for growth, development and chemical characteristics. Plant height and number of leaves per plant in all WGL lines were similar to that of parental cultivar Wiślica. There were some significant variations for leaf characteristics. The most distinct effect was extended duration of the vegetative stage. All the WGL lines showed delayed flowering compared to Wiślica. The WGL lines were inferior to the parental cultivar with regard to weight of 10 dm² of leaf blade. The cured leaf yield of most of the WGL lines was higher than that of Wiślica. There were no major differences for nitrogen, sugars and nicotine contents. The results from the study indicate that incorporation of the *N. glauca*-type resistance into tobacco genome did not cause unambiguously compromising effects on the usability of tobacco.

INTRODUCTION

Chalara elegans (Nag Raj and Kendrick) syn. *Thielaviopsis basicola* (Berk. & Broome) Ferraris is a soil-borne fungal pathogen that causes black root rot disease on tobacco (*Nicotiana tabacum* L.). Resistant cultivars with *N. debneyi*-type resistance are now available in Europe, including Poland (Berbeć 2008) and also in Canada (Haji et al. 2006) but an alternative source of resistance would be highly desirable. The studies carried out in 2000-2005 on hybrids between cultivated *N. tabacum* cv. Wiślica with wild species *N. glauca* led to the selection of black root rot resistant individuals (Trojak-Goluch and Berbeć 2005). These results indicated the possibility of *Ch. elegans* resistance factor being incorporated into the tobacco genome. Thus the assessing of *N. glauca* introgression effect into *N. tabacum* has acquired much practical significance. With this in view, a three year study was conducted on principal agronomic traits in advanced BC₂F₅- BC₂F₇ WGL lines compared to the parental Polish flue-cured cultivar Wiślica.

MATERIALS AND METHODS

The initial plant material were interspecific breeding lines of *N. tabacum* cv. Wiślica x *N. glauca* previously obtained from backcrossing sesquidiploids BC₁ to the recurrent tobacco cv. Wiślica followed by a number of self-pollination until BC₂F₅- BC₂F₇ generations. Finally ten breeding lines dubbed WGL were selected for detailed evaluation. Field experiment conducted in the years 2006-2008 included assessment of growth, development and chemical parameters in WGL lines compared to parental cultivar Wiślica. The experiment design was randomized blocks with three replicates and included 11 genotypes. Plot size was 36 m², plants were spaced at 90 x 40 cm, 100 plants per plot. Data were collected for: plant height, number of leaves per plant, number of days from transplanting to the appearance of the first flower, width and length of the 10th leaf on the stalk. Cured leaves from each entry were analysed for such parameters as weight per plot (yield), weight per ten leaves, weight per 1 dm² of leaf blade, contents of sugars, proteins and nicotine. The Dunnett least significant difference (LSD) was used to compare parameters of morphology and leaf yield.

Figure 1. Plant habit of WGL line (a) and parental cultivar Wiślica (b)



RESULTS

The WGL lines closely resembled the parental cultivar Wiślica (Fig.1)

On the average the studied lines were almost in all cases taller than Wiślica (Table 1). All tested WGL lines tended to possess longer and wider midposition leaves than Wiślica. As a result, midstalk leaf area was larger than that of Wiślica, although for some WGL the difference was below the significance level

Table 1. Plant height, number of leaves, dimensions of leaves, days to flower of the WGL lines and their parental cultivar averaged across three years of the study

Genotype	Plant height (cm)	Number of leaves /plant	Midstalk leaves			Number of days to flower
			Length (cm)	Width (cm)	Area (cm ²)	
Wiślica	166.8	26.3	47.3	28.1	855.2	73.0
WGL 1	175.2	26.6	51.3	32.9 ¹	1085.4 ¹	78.4 ¹
WGL 2	170.0	25.9	49.7	31.7	962.6	75.6
WGL 3	179.7	25.8	52.7 ¹	31.3	1099.6 ¹	73.7
WGL 4	170.2	25.4	49.0	32.0 ¹	1008.8	74.0
WGL 5	170.5	25.6	50.4	30.4	986.5	77.8 ¹
WGL 6	178.4	25.7	50.6	32.2 ¹	1055.8	73.6
WGL 7	176.6	26.2	51.4	31.9 ¹	1053.2	79.5 ¹
WGL 8	182.4	26.2	52.4 ¹	32.1 ¹	1088.2 ¹	75.2
WGL 9	166.3	24.9	49.1	31.3	1003.4	73.5
WGL 10	175.5	25.9	50.5	31.3	1021.9	75.5
Dunnett	19.37	1.71	4.74	3.64	205.22	2.59

¹ Mean values within a column differ significantly from cv. Wiślica based on Dunnett test

Table 2. Duration of the period from transplanting to flowering in the WGL lines and in the parental cultivar Wiślica

Genotype	Number of days to flower, year			
	2006	2007	2008	Mean
Wiślica	74.37	70.40	74.24	73.00
WGL 1	81.43 ¹	74.73 ¹	78.96 ¹	78.38 ¹
WGL 2	76.70	72.03	78.02	75.58
WGL 3	74.20	71.63	75.13	73.65
WGL 4	72.70	74.90 ¹	74.47	74.02
WGL 5	75.73	79.67 ¹	77.89	77.76 ¹
WGL 6	74.27	71.83	74.60	73.57
WGL 7	82.23 ¹	77.23 ¹	78.90 ¹	79.46 ¹
WGL 8	76.17	73.53	75.89	75.19
WGL 9	74.17	71.40	74.86	73.47
WGL 10	74.43	72.83	79.13 ¹	75.47
Dunnett	6.51	3.30	3.89	2.59

¹ Mean values within a column differ significantly from cv. Wiślica based on Dunnett test

- Berbeć A., 2008: Znaczenie użytkowe i wartość kombinacyjna nowych linii ustalonych i mieszańców tytoniu typu Virginia. Studia i Raporty IUNG_PIB 13, 51-61 (in Polish).
- Haji H. M., Mishra S., Brandle J. E., 2006: Host plant resistance management strategies for the control of black root rot disease. CORESTA Congress Paris, France PPOST 08.
- Trojka-Goluch A., Berbeć A., 2005: Potential of *Nicotiana glauca* (Grah.) as a source of resistance to black root rot *Thielaviopsis basicola* Ferr. In tobacco improvement. Plant Breeding 124, 201-206.

REFERENCES

Table 3. Yield and physico-chemical characteristics of leaves of the WGL lines and the parental cultivar Wiślica averaged across three years of the study

Genotype	Weight of 10 leaves (g)	Weight of 1 dm ² leaf blade (g)	Yield t/ha	Total N (% ²)	Nicotine (% ²)	Sugars (% ²)
Wiślica	56.9	0.86	2.05	2.1	1.4	22.1
WGL 1	61.6	0.69	2.26	2.3	1.4	22.3
WGL 2	59.9	0.73	2.16	2.1	1.4	23.7
WGL 3	72.5 ¹	0.84	2.19	1.8	1.2	25.1
WGL 4	61.9	0.77	2.03	2.1	1.6	20.9
WGL 5	61.4	0.80	2.14	1.9	1.4	26.9
WGL 6	73.2 ¹	0.80	2.16	1.9	1.3	27.5
WGL 7	51.6	0.71	2.17	1.9	1.7	25.6
WGL 8	69.2	0.72	2.30	1.8	1.2	25.8
WGL 9	67.8	0.76	2.10	2.0	1.3	22.5
WGL 10	65.0	0.84	2.08	1.9	1.2	27.2
Dunnett	15.57	0.20	0.39	0.76	0.45	15.49

¹ Mean values within a column differ significantly from cv. Wiślica based on Dunnett test
² Percent of the dry matter