Resistance to Diseases in Wheat Collection Samples and Somaclonal Variants

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Abstract: More than 2000 wheat collection samples were studied for seedling resistance to 4 diseases. Noncoincidence of results obtained after inoculation of leaf segments placed on water solution of benzimidazole (60 ppm) and intact plants was found for 3 foliar diseases (leaf rust – *Puccinia recondita*, dark brown leaf spot blotch – *Bipolaris sorokiniana* and septoria glume blotch – *Septoria nodorum*). Sixty-three entries were resistant to leaf rust; 26 of them have gene for resistance *Lr26* (non-effective under field condition), 25 – gene *Lr24*, 4 – gene *Lr19*, 8 – gene *Lr9* and 2 – gene *Lr41*. Samples 181-5, Fielder, Butte 66, Raj 1972 and Soisson were moderately resistant to spot blotch; 181-5 – to common root rot caused by *Bipolaris sorokiniana* and Moking and MN 81330 – to glume blotch. Very high level of partial resistance to 3 diseases was found in late generations of somaclonal lines of weakly and moderately resistant initial genotypes: to leaf rust in lines of cv. Spica, to leaf spot blotch – in lines of 181-5, to common root rot – in that of 181-5 and cv. Vera; moderate resistance to glume blotch was identified in lines of cv. Spica.

Keywords: wheat; leaf rust; dark brown leaf spot blotch; common root rot; septoria glume blotch

Growing of resistant varieties is the cheapest and ecologically profitable method to control diseases in cereal crops. First and possible key step in their breeding is identification of new donors for resistance, i.e. samples with high level of the trait expression, easily transferred via crosses, and protected by genes for resistance, that are not widely used in currently grown cultivars.

During 10 years we assessed about 2000 wheat (*Triticum aestivum* L.) samples from Vavilov Institute of Plant Industry World Collection for resistance to leaf rust (*Puccinia recondita*), dark brown leaf spot blotch and common root rot (both caused by *Bipolaris sorokiniana*) and septoria glume blotch (*Septoria nodorum*) including that described in scientific literature as possessing new effective genes for resistance. Study of seedling resistance to 3 diseases was performed in laboratory conditions (luminescent light equipment, 20 000 lux, 22–24°C) with use of intact plants (1–2 leaves stage) and detached leaves inoculation.

Resistance to leaf rust. After inoculation of leaf segments placed on water solution of benzimidazole (60 ppm) (Mikhailova & Kvitko 1970) 105 samples were resistant to natural (Leningrad region of Russia) population of leaf rust but only 63 were resistant after inoculation of intact plants. Inoculation with clones virulent to *Lr 26* revealed that 21 samples possess this gene non-effective in field condition. Modified phytopathological test and effect of maleic hydrazide treatment on resistance expression (unpublished) were used for gene for resistance identification in 37 samples. It was shown that 25 from them have gene *Lr24*, four samples – gene *Lr19*, 8 – gene *Lr9* and 2 – gene *Lr41*. No one new effective gene was found in samples under study. These genes except *Lr41* are now widely used over the world and so all

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identified resistant genotypes are of little interest for breeding for resistance purposes. Moreover we identified the pathogen clones virulent to all genes above mentioned (except *Lr9*) that means possible decrease in effectiveness of them in the nearest future. We propose that earlier identification of new effective juvenile genes for wheat resistance to leaf rust in USSR and Russia (Krivchenko *et al.* 1990; Mikhailova *et al.* 1987; Mikhailova & Gultiaeva 1994; Makarova 1994) was resulted from genotype dependent induction of resistance by benzimidazole and replacement of lines cv. Thatcher with genes *Lr9*, *Lr19*, *Lr24* at early period of their distribution in USSR.

Resistance to leaf spot blotch was assessed in laboratory with use of inoculation of detached leaf placed on benzimidazole solution (60 ppm) by suspension of *B. sorokiniana* strain T spores. Several resistant genotypes were identified but most of them were susceptible when intact plants were inoculated. Earlier selected resistant samples 181-5 (Tyryshkin & Mikhailova 1993) and Fielder (Conner 1990) confirmed their moderate level of resistance; additional possible donors for resistance are Butte 66, Raj 1972 and Soisson. Susceptibility of many wheat genotypes described as resistant (Adlakha *et al*. 1984; Hetzler *et al.* 1991) may be result of benzimidazole effect or reflects difference in aggressiveness of inoculum used. Presence of isolates highly compatible with 181-5 and Fielder in the pathogen natural populations was shown indicating that the resistance could be overcome due to such isolates accumulation.

Resistance to common root rot. With use of modified "rolls" method (Tyryshkin 1997) moderate level of seedling resistance to the disease was identified only in sample 181-5 and monogenic mode of genetic control of the trait was shown. Varieties earlier described as resistant – Thatcher (McKenzie & Atkinson 1968), Neepawa (Harding 1972), Cadet (gene *Crr*) (Larson & Atkinson 1982) and Skala (Savel'eva & Maistrenko 1983) were susceptible in this study; it can be result of difference in aggressiveness of isolates used for inoculation and/or expression of the resistance only at later stage of plant ontogenesis.

Resistance to septoria glume blotch. More than 30 samples with moderate to high level of resistance to *S. nodorum* were identified after inoculation of detached leaves placed on benzimidazole solution but almost all of them did not confirm the resistance after inoculation of intact plants. Only two genotypes – Moking and MN 81330 can be recommended as donors of resistance for practical use.

Results of the collection study indicated a very low frequency of genotypes resistant to facultative pathogens; many samples are highly resistant to leaf rust but all of them possess well-known and widely used genes for resistance. So, creation of new donors for resistance is important task; somaclonal variability induction may be one of approaches to gain it.

Somaclonal variation for the diseases resistance. About 1200 regenerated plants were obtained from callus cultures of 6 spring wheat samples and families of R_2 generation with high level of resistance to the diseases were selected (Tyryshkin 1997). In next generations ($R_{3–5}$) most of lines obtained in *in vitro* cultures of susceptible initial genotypes lost their resistance. In lines of initial genotypes possessing any level of resistance to certain disease, constant selection of resistant forms in R_2–R_9 was performed and resulted in identification of non-segregating lines with high level of partial resistance: that of 181-5 with resistance to dark brown leaf spot blotch, 181-5 and cv. Vera with resistance to common root rot and that of cv. Spica with resistance to leaf rust. Level of resistance in selected lines is very high: disease scores for leaf spot blotch are 1–2 in somaclonal lines, being 3–4 in 181-5 and 6 (complete death of leaves) in susceptible control; that for root rot – 1 in somaclonal lines, 3 in 181-5, 4 in Vera and 5–6 in susceptible varieties. Leaf rust development on resistant lines in field conditions was 5–30%, susceptible checks were diseased up to 100%. Only moderate level of resistance to glume blotch was found in somaclonal lines (disease rating 3 according to 0–6 scale) of cv. Spica. No differential interaction with the causal agent was found for several lines resistant to dark brown leaf spot blotch and common root rot indicating possible durability of their resistance. Subcultivation of complex *B. sorokiniana* population on leaves of resistant lines (Tyryshkin & Voronkova 1997) resulted in lowering of level of resistance on some lines. Subcultivation on lines that kept their resistance led to lowering aggressiveness of the fungi to these lines and to susceptible varieties.

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