O.45 - Regional distribution of Barley Yellow Dwarf Virus (BYDV) strains in Korea and identification of resistant wheat

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Abstract

Barley Yellow Dwarf Virus (BYDV) has been a major disease causing a severe loss of yield in winter cereals worldwide. It has been recently reported that BYDV occurs frequently in wheat fields and also causes serious yield reduction in Korea. This study was undertaken in order to investigate the regional distributions of BYDV strains in Korea and to identify the r cultivars or lines of wheat resistant to the predominant BYDV strains, providing basic information for the breeding of BYDV-resistant wheat varieties. Using RT-PCR and *Eco*RI digestion methods, the regional distribution of BYDV strains in Korea from 2006 to 2007 showed that PAV strain was mainly detected about 65% (Vic-PAV 52.6%; CN-PAV 47.4%) and MAV strain about 3%. Using ELISA test for the examination of BYDV resistance with 17 cultivars and four lines among Korean wheat, three cultivars, Gurumil, Topdongmil, and Olgurumil, were susceptible to BYDV and the others were resistant. In plant growth and yield component responses to BYDV infection, Gurumil showed significant difference between the uninfected and the infected, suggesting that it is the most susceptible to BYDV among Korean wheat, but Eunpamil and Seohae118 did not show a difference, an indication that they have the highest resistance.

Barley Yellow Dwarf Virus (BYDV) is the important aphid-borne and phloem-limited luteovirus that infects all major cereal crops including barley (*Hordeum vulgare* L.), wheat (*Triticum aestivum* L.), oat (*Avena sativa* L.), and other wild grasses as well. BYDV is found worldwide in 54 countries from seven continents. Strains related to BYDV-PAV, which are typically more damaging among BYDV strains, have been found to be the most prevalent in more than 50% of the countries surveyed (Lister and Ranieri, 1995). The virus interferes with physiological processes within the plant and in turn causes the symptoms of chlorosis, stunting and yield loss (Jensen and D'Arcy, 1995). Common effects of the virus on agronomic characteristics include reductions in yield, yield components, height, aboveground dry weight and root growth (Baltenberger *et al*., 1987; Burnett and Gill, 1976; Carrigan *et al*., 1981; Hoffman and Kolb, 1997).

Present virus control strategies include cultural practices such as varying the sowing date to avoid immigrations of viruliferous aphid vectors and applying insecticides to reduce the spread of aphids within crops (Gourmet *et al*., 1996; Wangai *et al*., 2000). However, neither of these methods is very satisfactory. Currently, the development and use of cereal varieties exhibiting resistance is the preferred approach for control (Plumb and Johnstone, 1995; Burnett *et al*., 1995).

In barley, a recessive resistance gene, *yd1*, was identified in the cultivar Rojo (Suneson, 1955), but it was rarely used in plant breeding programmes because it confers a low level of resistance. A semi-dominant resistance gene, *Yd2*, was identified in Ethiopian barley and mapped to the long arm of chromosome 3, based first on morphological markers and more recently on restriction fragment length polymorphism (RFLP) markers (Collins *et al*., 1996; Schaller *et al*., 1964). The *Yd2* gene confers a high level of resistance and has been widely used in plant breeding programmes (Delogu *et al*., 1995). Although major genes for resistance were found in barley soon after the discovery of BYDV, it was not until recently that major genes were reported in wheat. In bread wheat, tolerance exhibited in the cultivar Anza and other wheat lines is conditioned by a partially dominant gene, *Bdv1*, that has been identified in wide crosses with Agropyron (Singh *et al*., 1993). Other tolerance genes also exist, but the variations at tolerance level

found in wheat are not as high as that found in barley. Most of the tolerance in wheat appears to be quantitative in nature (Cisar *et al*., 1982). Researchers have suggested that tolerance to BYDV in wheat should be characterised in terms of yield and components of yield (Hoffman and Kolb, 1998). However, it is also important to measure virus concentration within the plant in the aspect of true resistance (i.e. relatively low virus production). For measuring BYDV concentration, virion purification (Jedlinski *et al*., 1977) and serological assays (ELISA) (Skaria *et al*., 1985) have been used to estimate BYDV capsid protein antigen titer as an index of resistance. The ELISA test is relatively quick and simple, especially when a large number of genotypes need to be evaluated.

Nowadays, it has been reported that BYDV occurs frequently in Korea and causes severe growth retardation and yield loss in wheat fields. Thus the breeding of wheat cultivars resistant to BYDV is needed to limit economic losses from this disease. The objectives of this study were to investigate the regional distribution of BYDV strains in Korea and then evaluate the resistance to a Korean prevalent BYDV strain, PAV, in wheat. Resistance to BYDV was screened with ELISA tests, and then evaluated by the plant growth and yield component responses to BYDV infection. The results of this study will be useful as basic information for the breeding of wheat varieties resistant to BYDV.

Investigation of regional distribution of BYDV in Korea from 2006 to 2007 showed that mainly PAV strains were detected, 64.8% of the total 88 samples, and MAV strains only 3.4%. In addition, PAV strains were classified into Vic-PAV (52.6%) and CN-PAV (47.4%). The results indicate that PAV strains are the most prevalent BYDV strain in Korea. MAV strains were detected from samples collected at Goryong, Iksan, and Suwon. The RPV strains transmitted by an aphid vector, *Rhopalosiphum padi* L., have frequently occurred in the central Indiana State of America (K. L. Perry, unpublished report). We suggest that further investigation of MAV strain distribution should be accomplished centering on the regions, considering possible expansion of MAV strains. Since a vector *Rhopalosiphum padi* L. is also prevalent in Korea, it is required to identify RPV strains continuously.

Evaluation of BYDV resistance in 17 wheat cultivars and four wheat lines using ELISA tests showed that Gurumil, Topdongmil, and Olgurumil were susceptible to BYDV and the others were resistant. In plant growth and yield component responses to BYDV infection, Gurumil showed significant difference between the uninfected and the infected but Eunpamil and Seohae118 did not. Consequently Gurumil was the most susceptible cultivar to BYDV, and Eunpamil and Seohae118 were the most resistant ones. Cooper and Jones (1983) defined ‘immune’ as the ability of the host to prevent virus from reproduction and movement within the plant, ‘resistance’ as to reduce virus replication, and ‘tolerance’ as to exhibit few symptoms even in the presence of high virus titers. According to this definition, since both virus concentration within the plants and inhibition rate of growth and yield components by BYDV infection are low, Eunpamil and Seohae118 are resistant to BYDV infection. However, the absolute grain yield is an important criterion for breeding wheat varieties resistant to BYDV. Therefore, we need to evaluate BYDV resistance under conditions more typically found in growers’ fields.

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