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Characterization of seedling yellow rust resistance in wheat commercial cultivars, landraces and elite genotypes

from Syria and Lebanon

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Preamble

Stripe (yellow) rust caused by *Puccinia striiformis* f. sp. *tritici* (*Pst*) is the major threat to wheat production in Central, West Asia and North Africa. The host resistance has remained the most economical, effective and ecologically sustainable method for disease control. Identification of resistance genes in commercial cultivars and landraces is fundamental to breeding for durable resistance. Gene postulation (multi-pathotype test) is traditionally used in characterization of seedling resistance genes. In present study the seedling resistance genes were postulated in commercial wheat cultivars and landraces using an array of *Pst* pathotypes at seedling stage.

Materials and Methods

A total of 135 wheat genotypes including 87 lines from of ICARDA's breeding program, 17 released cultivars from LARI's and 31 accessions from purified Lebanese landraces were used in this study. Eleven pathotypes of *Pst* available at INRA-Grignon were used to inoculate the host materials with the ability to differentiate low and high infection types for *Yr1*, 2, 3, 4, 6, 7, 8, 9, 17, 25, 27, 32, *Sd*, *Su*, and *Sp* (De Vallavieille-Pope et al., 2012). The plants were scored individually 15–17 days after inoculation using a qualitative infection-type scale of 0 to 9 based on the presence of necrosis, chlorosis and the intensity of sporulation (McNeal et al., 1971) (Fig. 1)

Results and Discussion

Most of the landraces (58%) and 4% of elite germplasm were susceptible to all the tested *Pst* pathotypes indicating absence of effective *Yr*-gene in these genotypes. 10% of ICARDA's elite lines are among the resistant genotypes to all pathotypes, followed by Lebanese landraces (6%) and cultivars (5%). Resistance phenotypes of nine, three and two genotypes of the elite lines, cultivars, and landraces, respectively, were remained uncharacterized. *Yr27* (29%), *Yr7* (17%), *Yr6* (12%), *Yr3* (12%) and *Yr17* (6%) were the most common postulated genes in the cultivars whereas *Yr7* (24%), *Yr9* (12%), *Yr1* (9%), *Yr6* (9%) and *Yr27* (8%) were identified in elite lines. In landraces, *Yr25* (10%), *Yr3* (6%), *Yr7* (3%) and *Yr9* (3%) were the most frequent postulated genes. *Yr1* was only postulated in elite lines (9%) and *Yr4* was postulated in 3% of landraces and 3% of elite lines (Fig. 2).

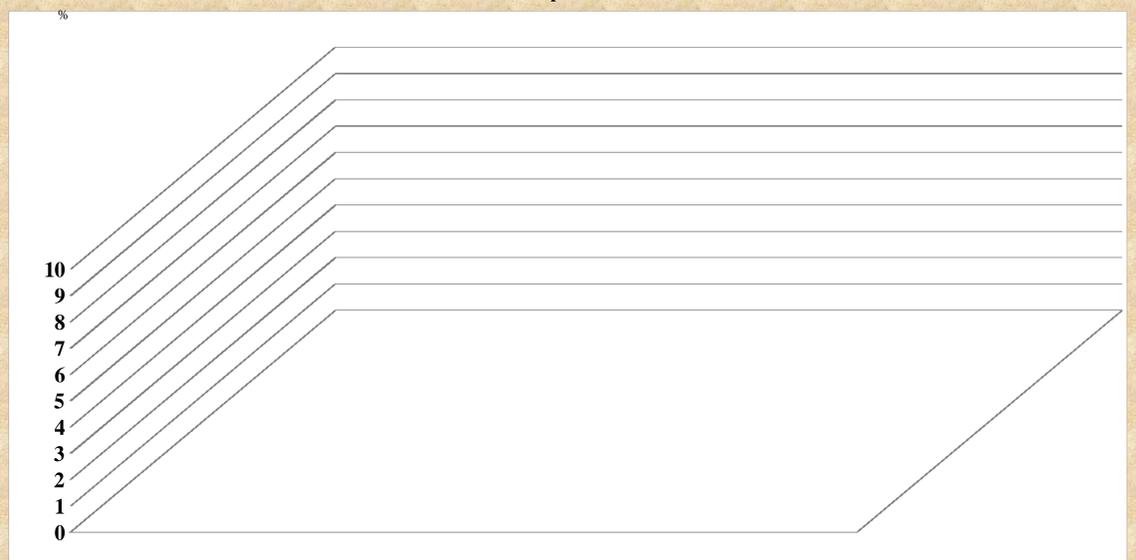


Fig. 1 : seedling infection type (Left to Right) : incompatible reaction 0 to compatible reaction 9.

Fig. 2: Distribution of *Yr* genes postulated in 87 elite lines, 17 commercial cultivars and 35 wheat landraces

Conclusion

Based on race analysis, *Yr1*, *Yr3*, *Yr4*, *Yr5*, *Yr10*, *Yr15* and *Yr32* are still effective against all Syrian and Lebanese races (Fig. 3) and can be used in combination for developing new resistant wheat cultivars. Since frequency of gene combination of some *R*-genes (i.e. *Yr1*, *Yr3* and *Yr4*) in commercial cultivars is low, utilization of these genes alone in farmer cultivars could result in consequent boom and bust cycle. The gene postulation seedling resistance gene in these genotypes should be complemented with characterization of adult-plant resistance genes. Gene-pyramiding strategy by use of effective seedling resistance genes with adult-plant resistance genes would provide durability of resistance to yellow rust (Paillard et al., 2012). Present data can be used in national breeding programs in Lebanon and Syria as well as at regional scale.

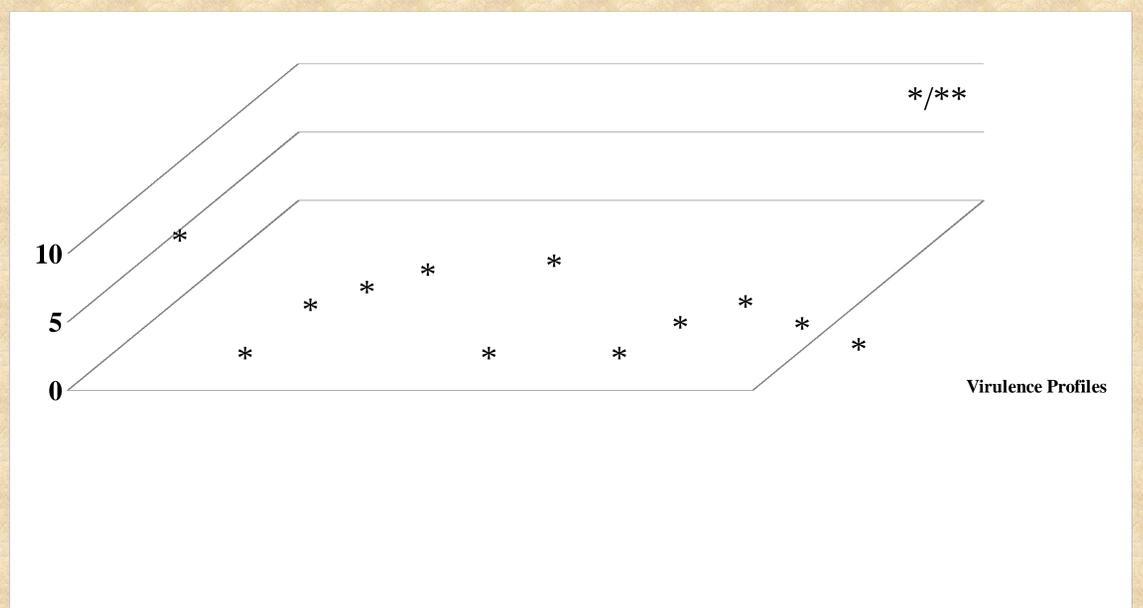


Fig. 3 : Distribution of *Pst* races sampled in major bread and durum wheat areas in Syria in 2011 using the BGRI surveillance protocols. In total, 223 samples were collected from 44 fields and characterized for their virulence and SSR profiles.

*Indicates a SSR profile similar to the invasive PstS1/2 strain genotype obtained using 20 SSR markers (Ali et al., 2010).

**Indicates both pathotype and SSR genotype corresponding to PstS2 strain (Hovmøller et al., 2008)

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