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Short Communication

Near-isogenic lines in NP 4 background carrying the genes *Lr13, Lr18, Lr19* and *Lr26* as locally adapted differentials for Indian pathotypes of wheat leaf rust

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Abstract

A backcross programme was conducted to transfer 13 of the *Lr* genes present in the leaf rust differentials being currently used in India *viz*., *Lr1, Lr2a, Lr2c, Lr3a, Lr9, Lr10, Lr13, Lr15, Lr17a, Lr18, Lr19, Lr20* and *Lr26* in the background of wheat variety NP 4 having desired agronomic traits. Homozygous resistant lines carrying these genes singly have been developed through six backcrosses and subsequent selection. Nine of these lines have already been reported. Present communication reports the remaining four lines carrying the genes *Lr13, Lr18, Lr19* and *Lr26*. These lines being locally adapted and early maturing are easy to maintain under Indian conditions, and can be widely used for virulence analysis and genetic studies.

Key words: Near-isogenic lines, *Lr* genes, wheat, leaf rust differentials, *Puccinia triticina*, NP 4

Leaf rust caused by *Puccinia triticina* Eriks. (*Pt*) is most common among three rust diseases of wheat (*Triticum aestivum* L.). Leaf rust differentials being currently used in India consist of sets 0, A and B which include eight Indian wheat genotypes, eight Thatcher (Tc) backcross lines carrying *Lr14a*, *Lr24*, *Lr18*, *Lr13*, *Lr17a, Lr15*, *Lr10*, and *Lr19*, and seven wheat varieties *viz*., Loros (*Lr2c*), Webster (*Lr2a*), Democrat (*Lr3a*) Thew (*Lr20*) Malakoff (*Lr1*) Benno (*Lr26*) and HP 1633 (*Lr9*), respectively (Nayar et al. 2001). All the lines from sets 'A' and 'B', but only IWP 94 (*Lr23*) from set '0' are being utilized in differentiating the Indian pathotypes (*Pt*). Maintenance of the Tc-backcross lines in set 'A' and most varieties in set 'B' is difficult due to their late maturity which limits their utilization in virulence analysis and genetic studies under Indian conditions. Hence, need was felt for developing near-isogenic *Lr* lines in the background of an early maturing locally adapted variety with the objective of facilitating their seed production and easy maintenance under Indian conditions, particularly in the plains. Early maturing, slow rusting, heat, drought and lodging-tolerant, non-shattering, bold seeded variety NP 4, a local Mundia selection released in 1911 by the then Imperial Agricultural Research Institute, Pusa, Bihar (Jain 1994), and not carrying any *Lr* gene or suppressor factor for leaf rust resistance (Kaushal et al. 1982) was selected as background parent. Out of the above listed *Lr* genes, *Lr14a* and *Lr24* have little value as differentials because of their susceptibility and resistance, respectively, to all the known Indian leaf rust pathotypes. Resistance of the line Tc+*Lr14a* to three pathotypes *viz*., 11 (0R8), 63 (0R8-1), and 106 (0R9) is due to their avirulence to the background parent Thatcher (Mishra et al. 2001). Hence, a backcross programme was initiated in 1997-98 for transferring the aforesaid *Lr* genes, except *Lr14a* and *Lr24*, in NP 4 background. Tc-backcross lines carrying the target *Lr* genes were used as donors. A total of six backcrosses were done in succession followed by selection and testing which was completed

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Table 1. Comparison of seedling infection types (at 16-20°C) to selected avirulent leaf rust pathotypes of the newly developed near-isogenic lines

Wheat genotypes	Seedling infection type[1]	Avirulent leaf rust pathotypes used for testing
KK10 (NP4+*Lr13*)	0;	11, 12, 16-1, 63, 106
RL4031(Tc+*Lr13*)	0;	
NP4	33+	
KK11 (NP4+*Lr18*)	0;2+	12, 12-4, 77A-1, 106, 162A
RL6009 (Tc+*Lr18*)	0;2+	
NP4	33+	
KK12 (NP4+*Lr19*)	;1	10,12-1,16-1,104-2,106,107
RL6040 (Tc+*Lr19*)	;1	
NP4	3+	
KK13 (NP4+*Lr26*)	0;	10, 11, 12-4, 12-8, 16-1, 17,
RL6078 (Tc+*Lr26*)	0;	63, 77, 77A-1, 106, 108, 162A
NP4	3+	

[1]As described by Roelfs et al. (1992)

in 2015-16. Intense selection was made during each generation for NP 4 plant type (awnless spikes and pubescent glumes) coupled with resistance phenotype of the target gene. The latter was identified in the field through syringe inoculation after 30-35 days of sowing with aqueous suspension of the uredospores of an avirulent pathotype. Leaf rust pathotype (pt) 12-2 (1R5) was used for selecting resistant plants carrying singly the gene(s) *Lr26*; pt 12-5 (29R45) for *Lr13* and *Lr19*; and pt 108-1 (57R27) for *Lr18*.

The plants thus developed through six backcrosses and selection putatively carrying the target *Lr* gene and closely resembling NP 4 phenotype, were selfed for two years in accordance with the standard guidelines (Allard 1960) to ensure uniformity. Selected material was seedling tested for identifying homozygous resistant lines, which were selfed for one more generation to get enough seed. These lines were further seedling tested with several avirulent pathotypes for confirming homozygosity for the target *Lr* gene. The seedling tests were conducted in a glasshouse under controlled conditions (16-20°C) at ICAR-Indian Institute of Wheat and Barley Research, Regional Station, Flowerdale, Shimla.

Close similarity between seedling infection types of the newly developed backcross lines and the corresponding donor lines confirmed successful transfer of the target *Lr* genes in NP 4 background (Table 1). Homozygous resistant lines carrying singly nine genes *viz*., *Lr1, Lr2a, Lr2c, Lr3a, Lr9, Lr10, Lr15, Lr17a* and *Lr20* have already been reported (Kaushal et al. 2015). These near-isogenic lines having early maturity and other desired agronomic traits of NP 4 are easy to maintain under Indian conditions, and hence, should be widely useful for virulence analysis and genetic studies.

Authors' contribution

Conceptualization of research (YMU, ANM, KK); Designing of the experiments (KK, ANM, YMU, MNP, SVSP); Contribution of experimental materials (ANM, KK, SCB); Execution of field/lab experiments and data collection (KK, SCB, SK); Analysis of data and interpretation (KK, AVM, SCB); Preparation of manuscript (KK, TLP, ANM).

Declaration

The authors declare no conflict of interest.

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