SHORT COMMUNICATION

Resistance in Indian wheat and triticales against loose smut caused by *Ustilago tritici*

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ABSTRACT: A total of 988 numbers of wheat and Triticales varieties and genotypes were evaluated against loose smut at hot spot locations, Almora in Northern hills zone, Ludhiana, Hisar and Durgapura in North Western plains zone of India under artificially inoculated conditions using local isolates of loose smut (*Ustilago tritici*) pathogen from 2007-08 to 2011-12 crop seasons. Ninety four genotypes and varieties of wheat and Triticales were found highly resistant (free from infection) whereas 20 genotypes and varieties were found resistant (0.1-5.0% infection) over years and locations. The wheat varieties, HS 277, KRL 210, MACS 2846, MACS 2971, VL 829 A-9-30-1, GW 1189, HD 4672, HI 8498, HI 8627, HI 8663, MPO 1215, NIDW 295, PDW 233, PDW 291, WH 896 NP 200 were highly resistant. These may be used for breeding for disease resistant as resistant donor parents and resistant wheat varieties may be deployment in disease endemic areas.

Keywords: Loose smut, resistant genotypes, triticales, *Ustilago tritici*, wheat

Loose smut of wheat (*Triticum aestivum* L., *T. durum* Desf. *T. dicoccum* (Schrank) Schubl.) and Triticales caused by *Ustilago tritici* (Pers.) Rostr. can cause considerable yield losses in cool and wet climate (Nielsen and Thomas, 1996). Although loose smut of wheat may be controlled effectively using seed treatment with systemic fungicides like carboxin, carbendazim, tebuconazole and thifluzamide (Goel *et al.*, 2001; Sharma *et al.*, 2001), it is not properly practiced by farmers due to high cost and non-availability of fungicides at sowing time in different regions as well as lack of any visible external visible symptoms on infected seeds. The use of *Trichoderma viride* as seed treatment before sowing could reduce the seed borne infection only to some extent (Singh *et al.*, 2000). The loose smut infected seed looks similar to healthy seeds and that also adds to non adoption of seed treatment. Therefore, use of loose smut resistant varieties is a better option for containing the disease in farmers' fields and reducing the uses of fungicides. Keeping this in view, the high yielding entries in various yield trials and nurseries of three cultivated wheat species and Triticales were evaluated against loose smut of wheat under artificially inoculated condition. This was a practical approach in view of scanty knowledge of DNA markers linked to loose smut resistance gene(s) that could assist the development of loose smut resistant genotypes.

The evaluation of agronomically promising genotypes and released varieties of wheat and Triticales was done at hot spot locations in cooler agro ecological zones (Northern Hills and Northwestern plains zones) of India during 2007-08 to 2011-12 crop seasons. A total of 988 wheat genotypes were tested for loose smut resistance which also included 74 released varieties as well as a highly susceptible variety, Sonalika as check. The total number of genotypes of bread wheat (*Triticum aestivum*), durum wheat (*T. durum*), Khapli wheat (*T. dicoccum*) and Triticales were, 726, 213, 35, and 14, respectively. The hot spot locations were, Almora in Northern hills zone and Ludhiana, Hisar and Durgapura in Northwestern plains zone in India.

Each genotype was sown in a 2 m long row at 23 cm spacing during mid-November and 5 panicles of each entry were inoculated at pre flowering growth stage '59' of Zadoks' scale (1974) with freshly collected loose smut teliospores using modified 'Go-go' method (Joshi *et al.*, 1988). The inoculated panicles were covered with butter paper bag. The seeds formed in inoculated panicles were sown for expression of disease in subsequent season. The crop was raised as per recommended agronomic practices and seeds were sown without treatment. The total healthy and loose smutted panicles were counted after its emergence and per cent infected tillers due to loose smut were calculated. The genotypes and varieties free from loose smut infection were categorized as highly

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Table 1. Highly resistant (HR) and resistant (R) of wheat and Triticale genotypes and released varieties to loose smut

Type of wheat	Genotypes and varieties (c)
Highly resistant (HR or Free from infection)	
<i>T. aestivum</i>	Varieties: HS 277, KRL 210, MACS 2846, MACS 2971, VL 829 Genotypes: DBW 41, DWR 63, GW 1255, HD 3016, HD 3065, HPW 348, HW 1095, HW 1096, HW 1097, HW 2308, HW 5304, MACS 2980, MACS 2981, MACS 2984, MACS 2985, MACS 5004, MACS 5009, MP 1201 (Q), VL 912, VL 914, VL 924, VL 914, VL 934, VL 941, WH 1107
<i>T. durum</i>	Varieties: A-9-30-1, GW 1189, HD 4672, HI 8498, HI 8627, HI 8663, MPO 1215, NIDW 295, PDW 233, PDW 291, WH 896 Genotypes: AKDW 3795-3, GW 1236, GW 1244, GW 1245, GW 1250, HD 4719, HI 8672, HI 8691, HI 8678, HI 8680, HI 8682, HI 8702, HI 8708, HI 8722, MACS 3744, MACS 3660, PDW 308, PDW 309, PDW 312, PDW 322, UAS 432, WHD 948
<i>T. dicoccum</i>	Variety: NP 200 Genotypes: DDK 1032, DDK 1036, DDK 1037, DDK 1038, DDK 1039, DDK 1040, HW 1098, MACS 2997, MACS 5012
Triticale	Triticale genotypes: DT 173, TL 2959, TL 2963, TL 2966, TL 2975
Resistant (R, having 0.1-5.0% loose smut infection)	
<i>T. aestivum</i>	Variety: PBW 396 Genotypes: HI 8681, HI 8714, HPW 360, HS 541, MACS 3742, UAS 429, WH 1100
<i>T. durum</i>	Varieties: AKDW 2997-16, HD 4672, PDW 291 Genotypes: AKDW 4021, MPO 1232, NIDW 505, PDW 313, PDW 324
<i>T. dicoccum</i>	Varieties: DDK 1009, DDK 1029 Genotype: DDW 15
Triticale	Genotype: TL 2961

resistant (HR) and those with 0.1-5.0% average infected tillers were classified as resistant (R).

The loose smut infection in susceptible check Sonalika ranged from 78.8-96.9% over years and locations indicating successful inoculation. The per cent smut infection in genotypes and varieties tested varied from 0-100%. A total of 94 genotypes and varieties of wheat and Triticale were found highly resistant with zero infection of loose smut whereas 20 genotypes and varieties were found resistant with an average disease ranging from 0.1-5.0% over years and locations. The resistance level to loose smut was highest in case of Triticale (42.8%), followed by *T. dicoccum* (37.1.3%), *T. durum* (23.9%), and least in *T. aestivum* (5.8%) genotypes and varieties. The bread wheat varieties, HS 277, KRL 210, MACS 2846, MACS 2971, VL 829 durum wheat varieties, A-9-30-1, GW 1189, HD 4672, HI 8498, HI 8627, HI 8663, MPO 1215, NIDW 295, PDW 233, PDW 291, WH 896 and Khapli wheat variety NP 200 were highly resistant to loose smut besides other genotypes. The resistant varieties to loose smut were, PBW 396, AKDW 2997-16, HD 4672, PDW 291 in durum, DDK 1009, and DDK 1029 in Khapli wheat (Table 1). These genotypes may be used as resistant donor parents for breeding for disease resistance in wheat and Triticale, and released varieties for deployment in disease endemic areas toward containing yield losses and reducing use of seed dressing systemic fungicides.

Role of *T. durum* and Triticale could be important in bringing down the loose smut incidence in wheat in cooler regions of India. The loose smut resistant bread wheat varieties, VL 829, KRL 210 and HS 277 in Northern hills zone and durum wheat varieties PDW 233, PDW 291 and WH 896 in North Western plains zone, can be used to manage the disease effectively. These genotypes of wheat and Triticale are in addition to those reported resistant to loose smut (Singh *et al.*, 2000, 2002).

The varieties highly susceptible (>50% infection) to loose smut were: C 306, DBW 14, DBW 17, DBW 39, DL 788-2, DPW 621-50, GW 322, HD 2733, HD 2888, HD 2864, HD 2932, HD 2967, HD 2985, HD 4672, HI 1500, HI 1563, HS 240, HS 295, HS 507, HPW 251, HW 2044, K 8027, K 0307, HUW 234, KHARCHIA-65, KRL 19, LOK-1, MACS 6222, MACS 2971, MACS 2496, MP 3288, MP 4010, MPO 1215, NI 5439, NIAW 1415, NW 2036, NW 2036, PBW 175, PBW 343, PBW 373, PBW 396, PBW 550, PBW 590, PDW 314, PDW 315, Sonalika, VL 804, VL 892, VL 907, WH 1021, WH 1080 and WHD 943. It is, therefore, recommended to use seed treatment in these varieties with systemic fungicides for management of loose smut in Northern hills and North western and Eastern plains zones of India.

The resistant and susceptible genotypes identified may be used for studies on genetics of loose smut resistance in wheat since the available information in this field is scanty. The genetics of loose smut resistance in an F5 derived recombinant inbred line (RIL) population of 94 lines from the cross of resistant genotype AC Foremost with a susceptible genotype BW278 to *U. tritici* race T10 was studied by earlier worker (Kassa *et al.*, 2012; Knox and Menzies, 2012). A single gene, designated *Ut6*, segregated for resistance to race T10 in the RIL population. A modified bulked segregant analysis identified a microsatellite marker linked to *Ut6*. The loose smut resistance gene *Ut6* mapped to the long arm of chromosome 5B. Five microsatellite markers mapped within 6.7 cM of *Ut6*. A diverse set of wheat lines was haplotyped for *Ut6* using the linked microsatellite markers gpw5029 and barc232. The microsatellite markers associated with *Ut6* will be useful for marker-assisted selection of loose smut resistant wheat lines (Kassa *et al.*, 2012). Nielsen and Thomas (1996) concluded on resistant genes to loose smut based on that genes can provide partial or completely resistance and

can be either dominant or recessive. The resistance stops the growth of the pathogen at one or more sites, e.g. in the ovary, embryo or seedling; although the embryo is genetically susceptible, the penetration of the fungi can sometimes be blocked by resistant maternal tissue of the ovary. Knox *et al.* (2012) identified four major and one minor QTL after crossing resistant and susceptible parents to loose smut. The wheat varieties may also be bred in future for loose smut resistance in addition to rusts and other foliar diseases for cooler climate of South Asian countries toward reducing use of fungicides and preventing yield losses.

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