academicJournals

Vol. 4(9), pp. 106-108, December, 2013
DOI 10.5897/JCO2013.0118
ISSN 2141-6591 ©2013 Academic Journals
http://www.academicjournals.org/JCO

Journal of Cereals and Oilseeds

Short Communication

Multilocation response of Afghanistan's seed chain wheat varieties to yellow rust under natural conditions during 2012 to 2013

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Accepted 18 November, 2013

Yellow rust is a potential threat to an already fragile Afghan wheat production system. The year 2009 to 2010 saw extensive yellow rust incidence in Afghanistan mainly due to *Yr27* virulence. The 2012 to 2013 crop seasons also had yellow rust incidence throughout the country. A set of 20 wheat seed chain varieties was grown at six agro climatically different locations in the country to proactively detect any shift in yellow rust virulence spectrum in the country. Yellow rust incidence on these varieties was scored under natural conditions during flowering to dough crop stages. Results revealed widespread susceptible reaction of at least four wheat varieties *viz.*, Diama 96, PBW154, Ghori 96 and Herat 99. Four other wheat varieties *viz*., Muqawim 09, Koshan 09, Rana 96 and Gul 96 showed susceptible reaction at least at one location; however, a total of 12 other seed chain varieties were confirmed resistant to prevalent yellow rust races under natural conditions. Results warrant caution in advocating susceptible varieties to farmers for commercial cultivation.

Key words: Wheat, Afghanistan, yellow rust, seed chain, variety.

INTRODUCTION

Wheat is the life-sustaining food crop of Afghanistan. At more than 200 kg, annual per capita wheat consumption in Afghanistan is one of the highest in the world (Persaud, 2012) and an average Afghan derives over 60% of his or her daily caloric intake from wheat (Government of Afghanistan, 2003). Wheat occupies about 2.5 million ha in Afghanistan–about 80% of the country's total cereal area. About 55% of this is rainfed with uncertain and unpredictable yield levels. Irrigated wheat is more productive, constituting 70 to 90% of domestic wheat production during the last several years (APR, 2012). The number-one national wheat production constraint is the lack of high-yielding, disease resistant varieties. Currently there are 16 varieties for irrigated conditions and only 4 for rainfed settings. The seed industry has grown phenomenally during the last few years with plans to achieve a 10% replacement rate, but that has not happened for several reasons (APR, 2012). Afghanistan is strategically located between Central and South Asia. With the recent discovery of a nearby alternate host for yellow rust (Jin et al., 2010) and stem rust race Ug99 having reached up to Iran (Sharma et al., 2013), Afghanistan constitutes a potential region for detecting new pathogen races evolving and/or advancing

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Table 1. Geographical locations of ARIA research sites where NRSN was sown

No.	Site	Latitude(N)	Longitude(E)	Altitude (m)	Mean temperature (°C)		Annual rainfall (mm)
					Maximum	Minimum	
1	Baghlan	36° 42′N	67° 13′E	510	26.6	-2.4	413
2	Balkh	36° 65' N	66° 96' E	387	33.1	1.1	200
3	Kabul	34° 28' N	69° 09' E	1841	26.5	0	550
4	Kunduz	36° 43' N	68° 51' E	373	31.5	0	348
5	Nangarhar	34° 49' N	70° 74' E	541	40.6	2	243
6	Takhar	36° 44′N	49° 30′E	804	27	2.3	NA

to more productive wheat fields in South Asia. A yellow rust attack early in the crop season can cause stunted plants and poor tillering, leading to severe yield losses. Afghanistan has managed to avoid severe wheat losses due to rusts by releasing resistant cultivars and by adopting a proactive approach to removing susceptible varieties from seed chains. This note reports natural incidence of yellow rust on Afghan seed chain varieties at six Afghan locations.

MATERIALS AND METHODS

The set of 20 seed chain wheat varieties (APR, 2012) were grown at six Agricultural Research Institute of Afghanistan (ARIA) research stations at six agro climatically diverse locations (Table 1) in Afghanistan. Each variety was sown in two 6-meter rows in an unreplicated National Rust Screening Nursery (NRSN). The nursery included several others yet to be released wheat lines; this publication only reports the reaction of seed chain varieties because of their importance and implications. All the locations were screened for yellow rust within a two-week period when nurseries ranged from flowering to dough stage. The yellow rust observations were recorded following a modified Cobb's scale (Peterson et al., 1948).

RESULTS AND DISCUSSION

The yellow rust scores varied from zero to 80 S across varieties and locations. A total of 12 varieties *viz*., Mazar 99, Parva -02, Solh -02, Pamir -94, Sheshambagh -08, Dorokshan -08, Lalmi -01, Lalmi -02, Chonte #1, Baghlan -09, Lalmi -03 and Darulaman -07 were found to be resistant across all locations (Table 2). Four varieties were resistant at all locations except one. Rana 96 was resistant at all locations except Kabul, where it had a score of 80S. Similarly, Muqawim 09 showed resistant type pustules at all locations except Balkh (40 MS), and Koshan 09 and Gul 96 were resistant at all locations except Nangarhar, where they had scores of 60 MS and 10 M, respectively. Ghori 96, a popular rainfed wheat variety, had susceptible scores from 10 MS-S to 80 S at 5 locations except Takhar where a resistant score of 5 MR was given. Similarly, PBW 154, a very old variety from India, had susceptible scores ranging from 20 MS to 80 S but had a resistant score of 5 MR at Takhar. In fact, Takhar seemed to have relatively less inoculum load as only two varieties, viz., Diama 96 (40 S) and Herat-99 (30 MS), were recorded as susceptible at this location (the same two varieties scored susceptible across locations).

Of the three rust diseases of wheat, yellow rust, caused by *Puccinia striiformis* (Jin et al., 2010), is the most prevalent in Afghanistan. Principally a disease of cooler climates (2 to 15°C), such as that of Afghanistan, yellow rust can cause extensive losses to wheat crops. Afghanistan is close to the natural habitat of alternate hosts for the disease and harbors ideal conditions for disease incidence throughout the crop cycle. The Afghan national agricultural research system and international maize and wheat improvement center (CIMMYT) jointly conduct a national rust screening nursery (NRSN) to detect any shift in rust races. The nursery comprises all final year yield evaluation trial entries, all seed chain entries, and all check varieties. The NRSN was grown and rust scores recorded for entries at six locations during 2012 to 2013 (Table 2).

The results reported here could be due to racial variations in the yellow rust pathogen across locations. Four nursery entries showed susceptible reactions at four or more locations and were therefore categorized as susceptible; these should be phased out of the seed chain to protect future wheat crops. The exceptional resistant or susceptible reactions of other entries at single locations were likely due to the absence or presence of pathogen races to which the varieties are susceptible. The 2012 to 2013 crop seasons saw widespread yellow rust incidence throughout Afghanistan and thus served as an opportunity to screen breeding material and varieties against this potential threat. The last widespread incidence was observed in 2009 to 2010 when the virulence for yellow rust gene *Yr27* was confirmed. The race analysis of samples collected during 2011 to 2012 crop season revealed the presence of several new combinations of new and old virulence. This year's yellow rust reactions are similar to last year's (Ahmadzada et al., 2013) except for that of entry Pamir 94, which was susceptible last year (40 MS). However, the similar response of most varieties to yellow rust over two years is enough to take remedial action to safeguard future

Table 2. Rust score* of some of Afghanistan's seed Chain varieties during2012-2013 crop season at six locations.

No.	Varieties	Nangarhar	Balkh	Baghlan	Kunduz	Takhar	Kabul
1	Mazar-99	TR	10 MR	20 M	20 MR	5 R	10 MR
2	Parva-02	TR	5 R	0	TR		5 R
3	Solh-02	0	5 R	10 R	0	5 MR	5 R
4	Ghori-96	10 MS-S	80 S	60 S	40 MS	5 MR	60 S
5	Pamir-94	5 MR	5 MR	0	0		20 MR
6	Muqawim-09	5 R	40 MS	10 MR	20 M	10 MR	10 MR
7	Sheshambagh-08	0	5 R	10 R	TR		20 MR
8	PBW-154	40 M		40 S	80 S	5 MR	20 MS
9	Dorokhshan-08	TR	5 R	10 MR	10 MR		10 R
10	Gul-96	10 M	20 MR	10 MR	10 MR	TR	20 MR
11	Lalmi-01	TR		5 R	10 MR		10 MR
12	Lalmi-02	TR	TR	10 R	10 MR	5 R	5 R
13	Chonte#1	TR	5 R	5 R	10 R		5 R
14	Rana-96	20 MR		5 MR	10 R	TR	80 S
15	Baghalan-09	10 MR	10 MR	10 MR	10 MR		10 MR
16	Lalmi-03	0	5 R	TR	20 MR		20 MR
17	Darulaman-07	20 MR	5 R	TR	5 R	TR	10 R
18	Daima-96	60 M	20 M	20 M	40 MS	40 S	40 S
19	Koshan-09	60 MS		TR	TR		10 R
20	Herat-99	40 MS		80 S	80 S	30 MS	80 S
Date and crop stage (Zadoks et al., 1974) of scoring							
Date		17.04.2013	09.05.2013	16.05.2013	14.05.2013	11.05.2013	28.05.2013
Stage (Zadoks scale)		73	83	83	83	73	71

*TR, Traces resistant; R, resistant: S, susceptible: M, mixed reaction: MR, moderately resistant.

wheat crops.

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