Evaluation of wheat germplasm against leaf and stem rusts under natural field conditions

[1]Javed Asghar Tariq, [1] Nazir Ahmed, [2]Zahoor Ahmed Soomro and [1]Ghulam Husain Jatoi

[1]Nuclear Institute of Agriculture (NIA), Tandojam, Pakistan

[2]Sindh Agriculture University Tandojam, Pakistan

Corresponding author's E-mail: jatariq_1411@yahoo.com

ABSTRACT

Current studies were conducted to scrutinize wheat lines against leaf and stem rusts in agro climatic condition of Sindh under natural field conditions at NIA, Tandojam. The disease severity was assessed following the modified Cobbs scale. The studies revealed that among tested 30 lines / varieties against stem rust, under natural conditions in rust screening nursary, 23 were screened as resistant, 4 moderately resistant, 1 genotypes showed MRMS type reaction and 1MS and 1 MSS fell susceptible. Among 24 lines / varieties tested against leaf rust under natural conditions in PYT, all were found to be resistant against leaf rust while 21 genotypes were found immune 2 were found resistant and one was rated as moderately resistant against stem rust.

KEY WORDS: Wheat, rusts, *Puccinia spp*, natural conditions

INTRODUCTION

Wheat (*Triticum aestivum*) is a staple food crop of the world and is major food crop in Pakistan, being cultivated over an area of 8666 thousand hectares annually, giving production of 23.5 million tons. Wheat is also a major source of dietary energy and protein for people having nutrients like Carbohydrates, Proteins, Fats, B-Vitamins and Minerals. Therefore, more emphasis is required for its sustainable production as it is a prime food weapon to attain food security. Its plant and seed can be used in various industrial products and as feed for livestock. Virtually all

parts of the plants are utilized, straw for animal bedding, organic matter for soil and oil for enrichment of other foods.

Wheat is subjected to a number of diseases which are responsible for reducing its overall production to great extent. The actual number of wheat diseases are unknown, approximately 200 diseases has been reported from different parts of the world. Among them rusts are most important one.

The occurrence of the rust diseases has significantly influenced the development of human civilization (Roelfs *et al.*, 1992). Rust diseases of wheat have historically been one of the major biotic constraints in Asia and all over the world (Singh and Rajaram, 1991). Among wheat rusts, leaf rust and stem rust are serious wheat production hazard now a day (Mecntosh *et al.*, 1995).

Leaf rust

Leaf rust is the most dangerous and devastating disease due to its time of appearance, nature of attack, regular occurrence and prolonged growing season that is essential for its development in the wheat growing areas of the world (Khan *et al.*, 1997). It can reduce total yield by about 1.0% for each 1.0% increase in the pathogens infection capacity (Khan *et al.*, 1997). In 1973 leaf rust intensity ranged from 40-50% with 100% infection occurring on susceptible wheat varieties (Hassan *et al.*, 1973). The severe leaf rust epidemic in Pakistan during the year 1978, resulted in an estimated national loss of US$ 86 million due to a 10% yield loss (Hussain *et al.*, 1980). Pathogen of leaf rust is a polycyclic with a capability to change its virulent nature faster than the release of new wheat varieties (Chaudhry *et al.*, 1996; Khan. 1987). Thus wheat varieties can not prolong their resistance in field, (Khan, 1987)

Stem rust

The other most dangerous and disquieting wheat rust is black or stem rust which has created alarming situation at global level. It is worldwide in distribution and affects wheat, wherever it is grown.

The stem rust fungus attacks all the aboveground parts of the wheat plant during wheat. Infected plants usually produce fewer tillers and set fewer seeds per head. Kernels became smaller in size, generally shriveled, and of poor milling quality. Heavy seedling infection of

winter wheat may weaken the plants and make them susceptible to winter injury and to attack by other pathogens. Under extreme situations, heavily infected plants may die. The amount of losses caused by stem rust may vary from slight to complete destruction of wheat fields over large areas, sometimes encompassing several states. More than 1 million metric tons of wheat is lost to stem rust in North America annually, and during years of severe stem rust epidemics, the losses are in the tens or hundreds of millions of tons.

The pathogen causing stem rust of wheat attacks and produces symptoms on wheat and other related cereals (barley, oats and rye) and grasses and on plants of common barberry (*Berberis vulgaris*) and certain other related species.

The symptoms on wheat appear as elliptical blisters or pustules, known as uredia that develop parallel with the long axis of the stem, or leaf sheath. Blisters may also appear on the neck and glumes of the wheat spike. The epidermis covering the pustules is later ruptured irregularly and pushed back, revealing a powdery mass of brick red-colored uredospores. The uredia vary in size from 1to 3 mm wide by 10 mm long. Later in the season, as the plant approaches maturity, the rusty color of the pustules turns black and the fungus produces teliospores instead of uredospore's and uredia are transformed into black telia. Sometimes telia may develop independently of uredia. Uredia and telia may exist on wheat plants in such great numbers that large parts of the plants appear to be covered with the ruptured areas, which are filled with either the rust-red uredospore's or the black teliospores or both. On barberry, symptoms appear as yellowish to orange-colored spots primarily on the leave. Keeping in view the demage caused by these rusts, There is need to search out a feasible control measure.

The most effective, and the only practical means of control of wheat rust is through the use of wheat varieties resistance to infections by the pathogen. A tremendous amount of work has been and is being done in the development of wheat varieties resistance to existing races of the fungus and the best varieties of wheat that combine rust resistance and desirable agronomic characteristics are recommended annually by the agriculture experimental stations. Present studies aimed to screen out resistant germplasm against leaf and stem rust under artificial and natural conditions.

MATERIALS AND METHODS

1. Screening of germplasm under artificial conditions

A) Plant Material

Thirty and twenty four wheat lines were sown in rust screening nursery and preliminary yield trial repectively, at Nuclear Institute of Agriculture (NIA) Tandojam, Sindh, to observe their adaptability and performance in agro climatic conditions of this area. The material was sown on 3rd week of December. Hand drill was used for sowing purpose. Each line was planted in one cm long row. Randomized Complete Block Design (RCBD) was used in the experiment. Morocco, a susceptible wheat variety, was used as a susceptible check and was sown at border of plot and was also repeated after each ten rows in the plot. All agricultural inputs were given to the crop at recommended doses. Field was left free for disease occurrence and no artificial inoculation was done. Field was visited regularly to observe disease appearance. Disease severity ratings were taken from appearance of initial symptoms up to crop maturity using the Cobb's scale.

C) Disease occurrence

Disease was found to be appeared in the end of March. Small brown pustules develop on the leaf blades in a random scatter distribution the pustules were circular, slightly elliptical, smaller than those of stem rust. Usually contain masses of orange to orange-brown urediospores. Infection sites primarily were found on the upper surfaces of leaves and leaf sheath and occasionally on the neck and awns.

D) Disease Screening

Rust data in the field was recorded as severity and response. For this purpose, Modified Cobbs' scale was used which represents six degrees of rust lines viz., 5, 10, 20, 30, 65, and 100%. The 100% severity accounts for 37% of the actual leaf area covered. Below 5% severity trace to 2% intervals are used. The response of a variety refers to the infection type and is classified according to the following letters:

Letter	Infection type
O	No visible infection
R	Resistant: necrotic areas with or without small pustules.

MR	Moderately resistant: medium sized pustules; no necrosis, but some chlorosis possible.
MS	Moderately resistant: medium sized pustules; no necrosis, but some chlorosis possible.
S	Susceptible: large pustules; no necrosis or chorosis.
X	Intermediate. pustules of variable size; some necrosis and or chlorosis

Severity and response readings are recorded together with severity first which are given below;

TR= trace severity of a resistant type infection

10MR= 10% severity of a moderately resistant type

50S= 50% range of reaction on each plant.

RESULTS AND DISCUSSIONS

Among tested 30 lines / varieties against stem rust, under natural conditions in rust screening nursary, 23 were screened as resistant, 4 moderately resistant, 1 genotypes showed MRMS type reaction and 1MS and 1 MSS fell susceptible. Among 24 lines / varieties tested against leaf rust under natural conditions in PYT, all were found to be resistant against leaf rust while 21 genotypes were found immune 2 were found resistant and one was rated as moderately resistant against stem rust.

Our data showed that sources of resistance against both the rusts disease are available in some wheat genotype tested under artificial and natural field conditions. On the basis of these finding, it can be proposed that sources of resistance identified from wheat germplasm, can be exploited in breeding programme for the development of disease resistance commercial cultivars

after determining their genetics. If these tested cultivars found good for other agronomic traits, then these can even be directly utilized for disease resistance after adoptability studies and development of production technology. Infect, there is a great need for developing simple, quick and practical methodologies on varietal screening and ratings of important crop diseases for adoption on uniform and global basis to facilitate breeding programmes. By now it is well know that the evolution of resistant varieties should better be broad-based containing polygenic vertical resistance, horizontal resistance (which is usually effective against many races of pathogen and is less subject to break down) and tolerance (a compromise between the host and the parasite), realizing that the resistance is not rigid, definite and quantitative parameter, but is flexible in the sense that no plant species is immune or 100 percent resistance to a disease.

Table-1. RESPONSE OF WHEAT GENOTYPES AGAINST STEM RUST UNDER NATURAL FIELD CONDOTIONS IN RUST SCREENING NURSARY

Sr. No	Genotypes	Stem rust Response
1	Mb-11	5MR
2	Mb-12	R
3	Mb-13	R
4	Mb-17	TMR
5	Mb-19	R
6	Mb-12	10MR
7	JMb-13	5MSS
8	AMb-17	R
9	Mbs-11	R
10	JMb-12	5R
11	KMb-13	10R
12	CMb-17	R
13	CMb-11	R
14	AMb-12	R
15	DMb-13	R
16	JMb-17	10MRMS
17	AHMb-11	R
18	MMb-12	5MS
19	Mb-1.1	R
20	Mb-1.7	R
21	Mb-1.1	TMR
22	Mb-1.2	R
23	JMb-13	R
24	ZMb-17	R
25	KMb-11	R
26	KMb-12	10R
27	TMb-13	R
28	Mbc-17	R
29	Mbn-11	R
30	Mbm-12	R

Table-2. RESPONSE OF WHEAT GENOTYPES AGAINST LEAF AND STEM RUST UNDER NATURAL CONDITION IN PRELIMANARY YIELD TRIAL(PYT)

Sr.No.	**Genotypes**	**Leaf rust**	**Stem rust**
1	JA-1	0	0
2	JA-3	TR	0
3	JA-5	0	0
4	JA-1.1	0	0
5	JA-1.2	0	0
6	JA-3.1	0	TMR
7	JA-5.1	0	0
8	JA-11	0	0
9	JA-17	0	TR
10	JA-32	0	0
11	JA-51	0	5R
12	JA-11	0	5R
13	JA-19	0	5R
14	TJA-3	0	0
15	TJA-5	0	10R
16	TJA-1	0	5R
17	TJA-1	0	0
18	TJA-3	0	0
19	TJA-5	0	0
20	TJA-1	0	0
21	TJA-1	0	0
22	TJA-3	0	0
23	TJA-5	0	0
24	TJA-1	0	0

REFERENCES

Bhatti, I.M and A.I Sommro 1996. Agriculture inputs and field crop production in Sindh. 2nd Ed. Directorate Genral. A.R.I Hyd pp.145.

Chandhry, M.H., M. Hussain and J.A Shah. 1996. Wheat rust scenario, 1994-1995. Pak. J phyopathology, 8:96-100.

Economic survey 2011-12 (Government of Pakistan Finance Division Economics Adviser's Wing Islamabad)

Hassan, S.F., M. Hussain and S.A Rizvi. 1973. Proceeding National Farmers and wheat Research Production. Islamabad. August 6-9, pp.231-234.

Hussan, M., S.F Hassan and M.A.S. Kirmani. 1980. Virulence in *Puccinia reccindita* Rob.ex Desm. F. sp. Tritici in Pakistan during 1978 and 1979. Proceedings of the fifth European and Mediterranean Cereal Rust Conference, Bari, Italy. pp.179-184.

Khan, M.A., L.E. Trevathan and J.T.Robbins.1997. Quantitative relationship between leaf rust and wheat yield in Mississippi. Plant Disease, 81:769-772.

Khan.M.A. 1987. Wheat variety development and longevity of rust resistance. Government of Punjab Agriculture Department, Lahore, pp. 197.

Melntosh, R.A., C.R. Welling and R.F. Park 1995. Wheat rust-An Atlas of resistance Genes, pp. 1-200.

Roelfs, A.P., R.P. Singh and E.E. Saari. 1992. Rust diseases of wheat. Concepts and method of Disease Management. CIMMYT, Mexico.pp.15.

Singh,R.P. and S. Rajaram. 1991. Resistance to *Puccinia recondite* f. sp. Tritici in 50 Mexican Bread Wheat Cultivars. Crop Science, 31:1472-1479.