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REGULAR ARTICLE

Estimation of genetic diversity for quantitative traits of commercial wheat (*Triticum aestivum*)

Adnan Rasheed[1*] and Abdul Malik Solangi[2]

[1]*Department of Plant Breeding and Molecular Genetics, Faculty of Agriculture, University of Poonch Rawalakot, Pakistan*

[2]*Wheat Research Station Tandojam, Sindh, Pakistan*

Abstract

This research was conducted to assess the performance of wheat genotypes and to detect genotypes with adult plant resistance by evaluating them in a trap nursery. 36 commercial wheat cultivar were used in experiment. Morocco was sown on four sides of trial. Material was sown in augmented design. The data was recorded on different quantitative like Plant height (cm), no. of tillers/plant, spike length (cm), no of spikelets/plant, peduncle length (cm), stem diameter (mm) and flag leaf area. Selection of genotypes could be done from two main clusters to make cross for improvement of traits. No of tillers/plant, peduncle length, spike/length, spikelets/plant and plant height showed large genetic variability in Biplot and these variables could be used as selection criteria. Pak-81, Sindh-81, Mexipak-65, Sarsabaz, Chakwal-86 and Kiran-95 so these cultivars could be potentially used in future breeding programme for improvement of several quantitative traits according to results of Biplot analysis. Following genotypes were found moderate resistant against yellow rust viz. Anmol-9, Bahawalpur-200 and Bakhtawar-92 and could be used further in future breeding programme to stand against yellow ruts pressure. Maxipak-65 and WL-711 need to improve by incorporating yellow rust resistant genes.

Key words: Quantitative; rust; traits; wheat

Introduction

The world major crop is wheat (*Triticum aestivum*) which has chromosome number of 2n=42 and it has great role in agriculture sector. The production during 2014-15 was 24.2 million tonnes against the target of (25.5) million tonnes, which is (5.1) percent fall while and there are still constant fluctuations in the production (Anonymous, 2015). Genetic diversity is the presence of different genes for several quantitative traits. Field trails are used for assessment of diversity which increase the scope of selection and could be used in future breeding program.

Rust, heat and drought are major yield limiting factors of wheat. Rust is most destructive diseases of wheat and creates huge loss in wheat yield as reported by Hussain and Ajmal (2011). Stripe rust (yellow rust), caused by (*Puccinia striiformis)*. Sp *tritici*is is one of the most destructive diseases of wheat in Pakistan. Main reason for threat of rust is lack of poly-genic resistance. Rust can be controlled by using resistant wheat varieties. 40 different rust resistance genes have been identified and used in breeding programs (Zubair et al., 2007). Leaf rust affects leaf of wheat and in

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*Corresponding Author

Adnan Rasheed

Department of Plant Breeding and Molecular Genetics, Faculty of Agriculture, University of Poonch Rawalakot, Pakistan

Email: adnanbreeder@yahoo.com

cold regions due to overwintering of pathogen which destroys winter wheat. It is destructive on winter wheat because the pathogen overwinters. Infections can cause 20% yield loss intensified by dead leaves which ignite fungus. *Puccinia triticina* causes stem rust, *P. recondita* causes 'leaf rust' and *P. striiformis* causes stripe rust'. It is the most widespread of all the wheat rust diseases (Roelfs, 1992).

Diversity is checked by using different statistical tools such as multivariate analysis etc. Cluster analysis and principle component analysis have efficiency to set efficient cross combinations (Machado, 2000). Cluster analysis is the most appropriate technique for choosing ergonomically or morpho-metrically diverse parents as it provides an assessment of actual difference between any cross in populations (Assefa et al., 2001). Factor analysis is most authentic technique used to understand the pattern of variability among traits based on structural relationship among them (Hair et al., 2006). Objective of current study was to estimate genetic variability for different quantitative traits of commercial wheat cultivars. To classify genotypes based on qualitative and quantitative into various groups. To check the adult plant resistance of commercial wheat cultivars against to yellow rust.

Materials and methods

Proposed Research study was conducted at the experimental field of Department of Plant Breeding and Molecular Genetics, Faculty of Agriculture, The University of Poonch Rawalakot, Azad Jammu and Kashmir. A total of 36 commercial wheat cultivars were used. Morocco was used as susceptible check. Morocco was sown on four sides of trial. Material was sown in augmented design. One-meter-long row was sown for each genotype and row to row distance was 30 cm. Recommended dose of urea was applied in split doses 3 to 4 times. Cultural Practices such as weeding hoeing were also carried out. Genotypes were screened for diseases reaction and certain morphological traits. Data was recorded on following quantitative traits. Plant height (cm), stem diameter, peduncle length, flag leaf area, number of tillers, spike length and spikelets/plant.

Assessment of diseases severity

Leogering (1959) modified Cobb's Scale.

- 0 =No observable infection.
- R=Resistant necrotic areas with or without minute uredia.
- MR =Moderate resistant, small uredia present surrounded by necrotic areas.
- MS = moderately susceptible medium uredia with no necrosis but probably some diverse chlorosis.

S = Susceptible, large uredia and a slight or no chlorosis present.

Statistical analysis

Cluster and principal component analysis was done by following Sneath and Sokal (1973) with the assistance of computer software 'Statistica' (www.statsoft.com), PAST Hammer et al. (2001) and 'SPSS' 20 (www.spss.com).

Table 1. List of commercial cultivars.

Genotypes	Genotypes	Genotypes	Genotypes
Bakhtawar -92	Shaheen- 94	LU- 26	Kohsar -95
Chakwal -86	Shahkar 95	Nowshera-26	Rohtas- 90
Sindh -81	Benazir –13	Parwaz-94	Suleman-96
Zarahoon	Tandojam-83	Pasban-90	WL -711
Faisalabad- 83	SH -2002	Maxipak-65	Zardana
Faisalabad -85	Pak- 81	Punjab- 96	Abadgar -93
Inqilab -91	Bahawalpur -97	Sariab-92	Anmol-91
Kaghan-93	MH- 97	Sarsabaz	Bahawalpur-2000
Kiran-95	Kohistan-97	Morocco	Shaheen -94

Results and discussion

Quantitative cluster

There were two main clusters named A and B which were located at genetic distance of 135 showed large amount of genetic variability. Bauer et al. (20007) and Kraic et al. (2009) described same studies for morphological and yield traits of wheat. Main cluster A was subdivided into two sub-clusters named a1 and a2 which were at genetic distance of 50. Sub-cluster a1 contained five genotypes out of them three were out layers named Sindh-81, LU-26 and Faisalabad-83 while Bakhtawar-96 and Bakhtawar-92 were from same group. Sub cluster a2 had three genotypes out of them Mexipak-65 was out layer. Out Layers showed large genetic variability. Main cluster B had two sub clusters named b1 and b2. Sub cluster b2 consisted of one genotypes Sarsabaz which contributed larger genetic variability towards selection. Sub cluster b2 consisted of 26 genotypes out of them SH-2002, WI-711, PAK-81, Fasialabad-85, Shaheen-94, Kaghan-93, Punjab-96 and Rohts-90 were out-layers which showed maximum genetic variability and could be selected for making cross. Other genotypes such as Chakwal-86, Benazir-93 from same group, Nowshera-26, Kohistan-97 from same group, Anmol-91, Bahawalpur-2000 and Shaheen-94 and Kaghan-93 belonged to same group e.t.c. These genotypes showed less genetic variability and could not be selected for future breeding program. As distance between clusters increases chance of selection would be increases and selection could be done on genotypes located at large genetic distance. Selection from two main clusters could be fruitful. Mohammadi and Prasana (2003) presented similar results through cluster analysis. Zubair et al. (2007), Ahmad et al. (2008) and Ali et al. (2009) also presented multivariate analysis with same results.

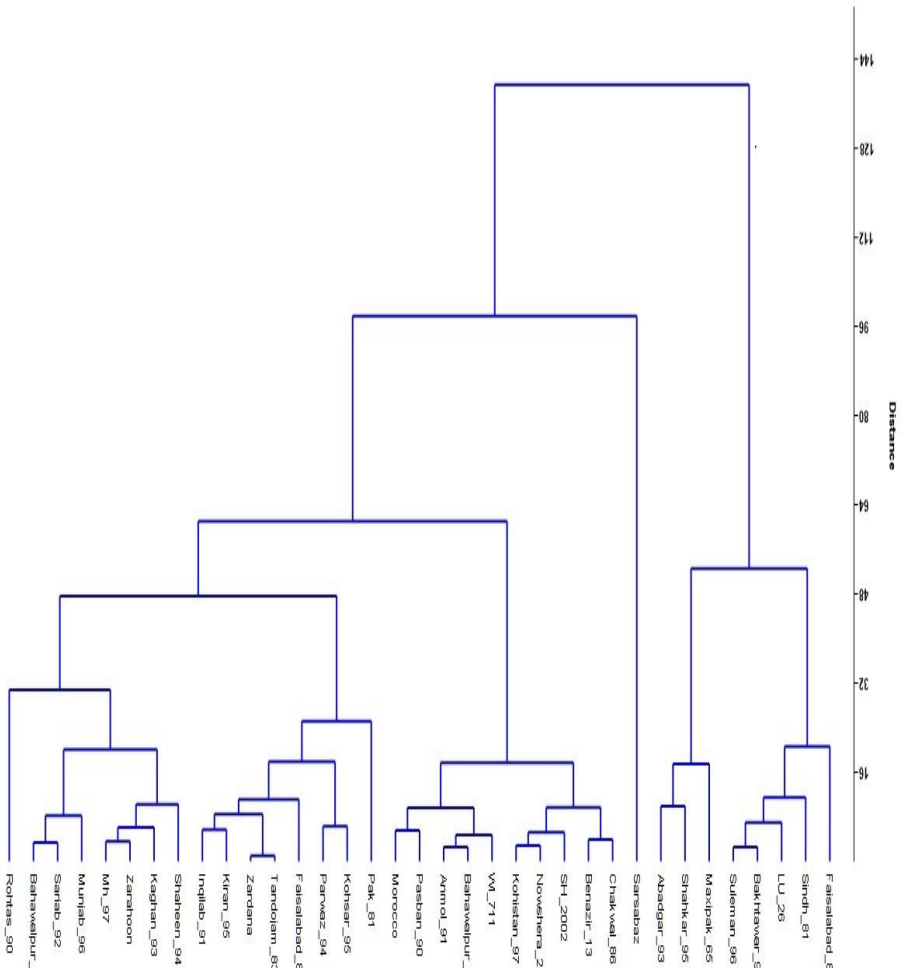

Fig. 2. Cluster analysis for 36 wheat genotypes.

Biplot for six quantitative traits

From Biplot analysis it can be seen that out of six quantitative traits of commercial wheat cultivars maximum genetic diversity was contributed by No, of tillers/plant, peduncle length, spikelets/plant and plant height hence these variables could be improved via selection of diverse genotypes and minimum genetic variability was shown by leaf area and spike length therefore these traits had no significance towards selection. Fufa et al. (2005) and Fotokian (2002) showed similar results. More diverse genotypes found in this diagram were Pak-81, Sindh-81, Mexipak-65, Sarsabaz, Chakwal-86 and Kiran-95 so these cultivars could be potentially used in future breeding programme for improvement of several quantitative traits. Less diverse genotypes were Inqilab-91, Pasban-90, Suleman-96, Nowshera-26 and Kohistan-97. Selection could not be practiced on these genotypes due to less diversity.

Response of commercial wheat cultivars towards yellow rust

Following genotypes were found moderate resistant against yellow rust viz. Anmol-91 and Bahawalpur-200. Genotypes with moderate resistant and moderate susceptibility behavior were Saraib-92 and Kohistan-97, genotypes with moderate susceptibility were Pak-81 and SH-2002 and complete susceptible genotypes were Maxipak-65 and WL-711. In case of yellow rust a straight line is formed along the leaf area. Resistance result in the spores' death and susceptibility result in spores' movement along the whole leaf area and lose of chlorophyll contents. When rust spores come on Morocco and goes inside the nursery then we can easily estimate the resistance and susceptibility of cultivars under diseases pressure and can easily be selected for breeding program. Rust nursery is basically used to estimate the resistance of commercial cultivars and then we selected genotypes on the basis of their resistance towards diseases. Morocco is a universally rust susceptible variety and has no gene of resistance therefore it is used a spreader in experiment conducted in field.

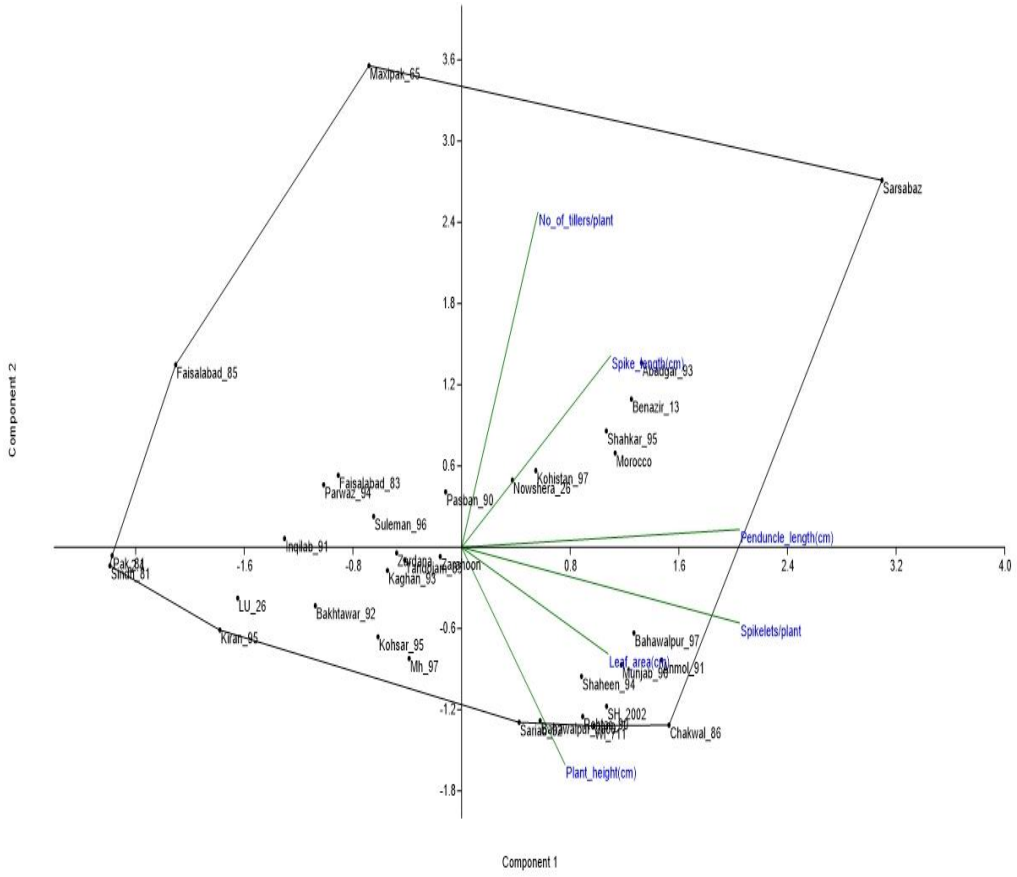

Fig. 2. Biplot analysis for six quantitative traits of commercial wheat cultivars.

Table 2. Response of wheat cultivars towards yellow rust.

Sr. No	Genotypes	Disease Severity	Sr.No.	Genotypes	Disease Severity
1	Faisalabad- 83	20MRMS	18	Sindh-81	80S
2	Faisalabad -85	10MRMS	19	Zarghoon	60S
3	Parwaz -94	70MRMS	20	Mexipak- 65	90S
4	Pasban- 90	60MRMS	21	Punjab- 96	90S
5	Sariab-92	80MRMS	22	Morocco	80S
6	Kohistan- 97	70MRMS	23	Shaheen- 94	90S
7	Kohsar-95	70MRMS	24	Rohtas-93	90S
8	Shahkar- 95	80MSS	25	Inqilab- 91	80S
9	Benazir-13	20MSS	26	WL- 711	90S
10	Tandojam -83	50MSS	27	Blue silver	MISSED
11	SH-2002	80MSS	28	Chakwal -86	20RMR
12	Pak-81	80MSS	29	Anmol-91	60MR
13	Bahawalpur-97	80MSS	30	Bahawalpur-2000	50MR
14	MH-97	70MSS	31	Bakhtawar- 92	60MS
15	Kohistan-97	70MSS	32	Chakwal 86	20RMR
16	LU-26	70MSS	33	Zardana	90MSS
17	Nowshera- 96	80MSS	34	Abadgar- 93	30RMR

Conclusion

Selection of genotypes could be done from two main clusters to make cross for improvement of traits. No of tillers/plant, peduncle length, spike/length, spikelets/plant and plant height showed large genetic variability in Biplot and these variables could be used as selection criteria. Pak-81, Sindh-81, Mexipak-65, Sarsabaz, Chakwal-86 and Kiran-95 so these cultivars could be potentially used in future breeding program for improvement of several quantitative traits according to results of Biplot analysis. Following genotypes were found moderate resistant against yellow rust viz. Anmol-9, Bahawalpur-200 and Bakhtawar-92 and could be used further in future breeding program to stand against yellow ruts pressure. Maxipak-65 and WL-711 need to improve by incorporating yellow rust resistant genes.

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Contribution of Authors

Both authors contributed equally in research work.

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