



Official publication of Pakistan Phytopathological Society
Pakistan Journal of Phytopathology

ISSN: 1019-763X (Print), 2305-0284 (Online)
<http://www.pakps.com>



PREVALENCE, INCIDENCE AND SEVERITY OF BROWN SPOT OF RICE IN MAJOR RICE GROWING AREAS OF PUNJAB, PAKISTAN

^aMuhammad Jabran, ^aAmjad Abbas, ^aGhulam Sabar, ^bGhulam Mustafa, ^{a,b}Muhammad A. Ali*

^aDepartment of Plant Pathology, University of Agriculture, Faisalabad, Punjab, Pakistan.

^bCentre of Agricultural Biochemistry and Biotechnology, University of Agriculture, Faisalabad, Pakistan.

ABSTRACT

Brown spot disease (*Bipolaris oryzae*) is increasing threat to global food security in the world as well as the most damaging disease of rice crop in Pakistan. In September 2017, a field survey was conducted in four rice-growing districts of Punjab namely (Faisalabad, Hafizabad, Sheikhpura and Lahore) and diseased samples were collected from different fields of rice showing disease symptoms. The results showed that Ninety-seven fields of rice were surveyed and 62 were found infected with disease. Disease prevalence was highest in district Sheikhpura 84%, followed by Lahore, Hafizabad and Faisalabad with 80%, 60% and 53% respectively. The risk of disease incidence was highest in district Sheikhpura and Lahore 82% in Super Basmati, 74% in KSK-282 followed by Faisalabad and Hafizabad 71% in Super basmati, 60% in Super rice respectively. The severity rate was the highest in district Lahore at KotPindiDass 88% in Super rice, but the minimum was observed at Shamke road 46% in PK 386. It is concluded that, the disease incidence and severity level of *B. oryzae* was higher in fields of district Sheikhpura in Punjab, Pakistan.

Keywords: Brown spot of rice, *Bipolaris oryzae*, Disease Prevalence.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most economically important crop in the world which provides vitamins, minerals and fiber to the large number of the population around the globe. It is the second most important cultivated cereal crop after wheat in the world (Darfour and Rosentrater, 2016). It is considered as a staple food in the most part of Subcontinent, especially in Bangladesh and Sri-Lanka. China holds the main position in production of rice while India has the second and producing 99.15 million tons in the world (Anonymous, 2007). The shares of China and India were 34.2%, 21.7% respectively, which is contributing 50% of the rice production in the world (Anwar, 2010). In 1912, the improvement of the rice crop was initiated in Larkana, Sindh in Pakistan. After that, it moved to Dokri and Kala Shah Kaku in Punjab. More

than Fifty varieties have been approved, certified and cultivated in different regions of Pakistan. In all the provinces of Pakistan, rice is produced, but it is mainly cultivated in Central Punjab i.e. district of Lahore, Sheikhpura, Gujranwala, Sialkot, Nankana Sahib, Faisalabad, Gujrat, Sahiwal, Toba Tek Singh, Pakpattan, Kasur and Hafizabad. Rice crop is contributing 0.6% of GDP. The crop is most cultivated under diverse climatic and better soil circumstances in Pakistan (Azam & Shafique, 2017).

Rice crop is attacked by a variety of biotic (Pathogen, Insects and pests) and affected by abiotic (Weather conditions, nutritional) stresses. Among the important diseases of rice, Brown spot is a major damaging disease in the world. The pathogen of Brown spot of rice disease is *Bipolaris oryzae*, which caused the severe infection of rice leading to physiological and genetic changes in rice (Arshad *et al.*, 2008). The typical symptoms of brown spot disease are small and circular, oval shaped dark brown spots are appeared and pathogen infects the glume, coleoptile, panicles, grains and specially to leave (Webster *et al.*, 1992). The research outcome of Roul and Mishra (2014) who described, that brown spot is an airborne disease. He

Submitted: November 03, 2019

Revised: December 01, 2019

Accepted for Publication: December 23, 2019

* Corresponding Author:

Email: amjad.ali@uaf.edu.pk

© 2017 Pak. J. Phytopathol. All rights reserved.

reported that maximum relative humidity and very high temperature are the causes of this disease severity. The poorly managed rice fields were also detected. Groth and Bond (2007) described, that water can cause primary inoculum of disease to be sustained in the straws of rice and then carry on to spread resulting increases incidence of disease.

A number of researchers have reported yield losses of brown spot of rice regularly expressed in comparative terms, 4 to 29 % by Bedi and Gill in 1960, around 12 % by Aluko in 1975, 8 to 23 % by Fomba and Singh in 1990 and Chakrabarti in 2001 projected 26 to 52 percent. The disease especially occurs in environment where water supply is scarce combined with nutritional imbalance particularly lack of nitrogen (Baranwal *et al* 2013). Late sowing of rice, insufficient water and heavy rainfall in the rice field causes the reduction of the crop yield by promoting this disease (Bashir *et al.*, 2010). Use of resistant varieties is the best and reasonable solution to control the brown spot of rice (Bonman, 1992). Seed coating with many medicines like *Trichoderma harzianum* can reduce effect up to 70% of this disease (Chinmay *et al.*, 2010). Another effective option for the disease management is the host resistant. In Punjab, Pakistan, the information on prevalence of brown spot of rice is rare, because most of the research has focused on the efficacy of chemicals to overcome the infection of the seeds. The disease brown spot is managed in Uganda by the usage of chemical and

cultural control in the rice growing fields (Biswaset *al.*, 2011). Brown spot disease is the task to enhance the production of rice (Mwendo *et al.*, 2017). The aim of the present study was to provide emerging reports of brown spot disease in the main rice producing district of Punjab. This research would support to the grower in decreasing the loss of yield caused by brown spot of rice.

MATERIALS AND METHODS

Survey for prevalence of Brown spot of fine rice:

Surveys were conducted during September to October 2017 for the prevalence of brown spot of rice in main rice producing districts of Punjab including Sheikhpura, Lahore, Hafizabad and Faisalabad (Figure 1). Different diseased samples of typical symptoms of brown spot of rice were collected for the isolation, purification and identification of the pathogen. The pathogen *B. oryzae* was isolated by using single spore technique from the diseased leaf tissue. In district Faisalabad 41 locations were visited while in district Hafizabad, Sheikhpura and Lahore, 28, 13, 15 respectively. Global positing system (GPS) reading of each rice field and the variety of the rice crop noted. The Longitude/Latitude also calculated of each field. The assessment of disease was observed based on symptoms of brown spot of rice.

The prevalence of brown spot disease was recorded as percentage of rice areas showing the disease symptoms, out of the total number of rice fields evaluated (Moundeet *al.*, 2009).

$$\text{Disease prevalence \%} = \frac{\text{Number of locations with disease symptoms}}{\text{Total number of locations}} \times 100$$

The incidence of disease also was calculated as the percentage of plants, indicating disease symptoms, expressed as a proportion of the total number of plants evaluated. Disease incidence was designed by the following formula (Teng and James, 2002).

$$\text{Disease incidence \%} = \frac{\text{Number of diseased plants at a location}}{\text{Total number of plants inspected at a location}} \times 100$$



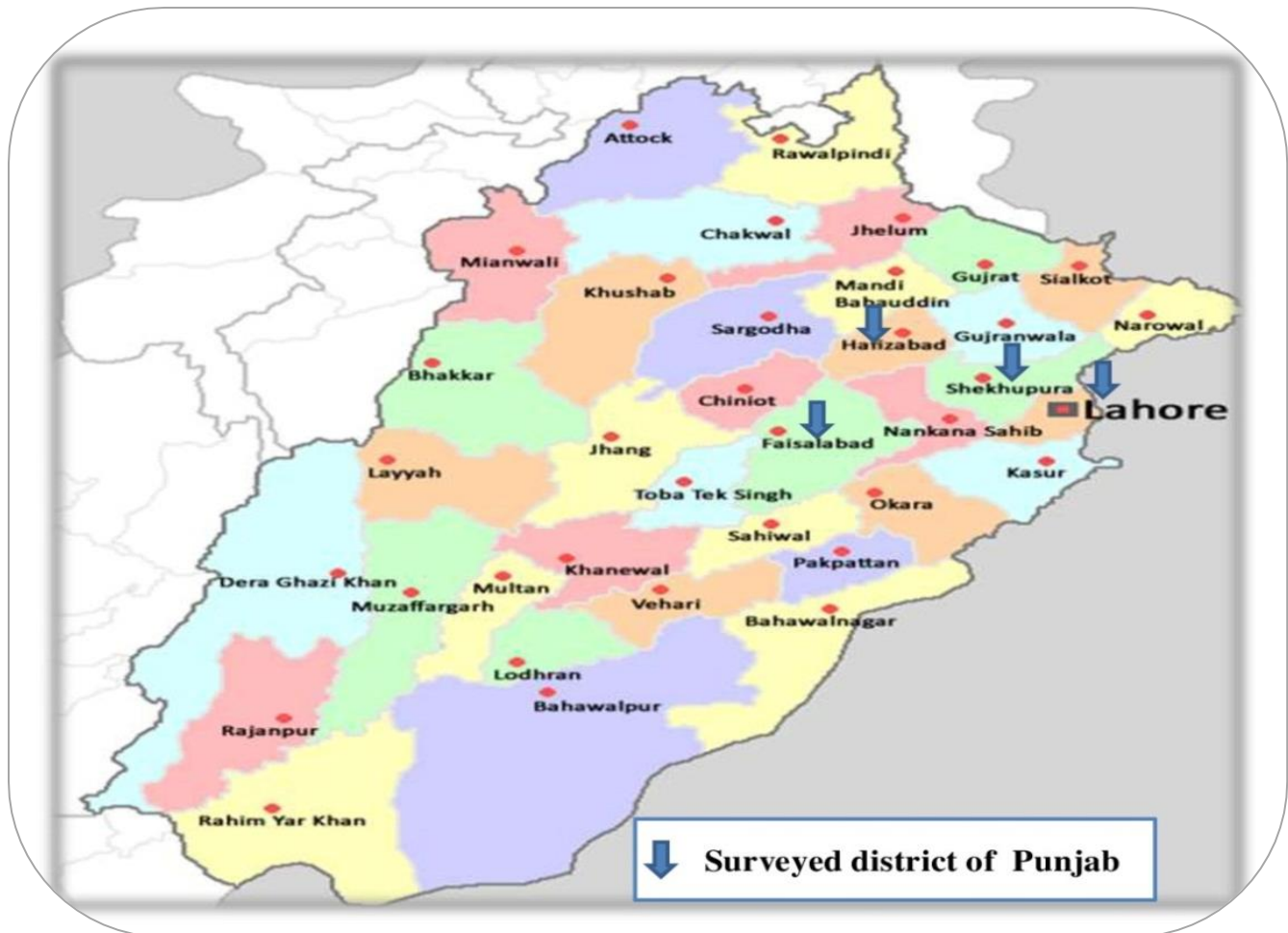


Figure 1. Map indicating the surveyed district of Punjab for Brown Spot of Rice
 Overall, 97 rice fields of farmer were surveyed in the Punjab districts. Fields were selected for samples along the roads, canals, research stations. Three diseased samples were randomly collected from each location for isolation and purification of the pathogen. A number of rice plants infected and severity of brown spot disease was calculated from each field. However the disease severity was determined following disease rating scale in Table 1 (IRRI, 2013).

Scale	Affected leaf area
0	No disease observed
1	Less than 1%
2	1-3%
3	4-5%
4	6-10%
5	11-15%
6	16-25%
7	26-50%
8	51-75%
9	76-100%

RESULTS

Brown spot disease was present in all rice growing district i.e Faisalabad, Hafizabad, Sheikhupura and Lahore. The disease prevalence

was maximum reported in district Sheikhupura 84%, followed by Faisalabad, Hafizabad, and Lahore with 53%, 60% and 80% respectively (Figure 2).

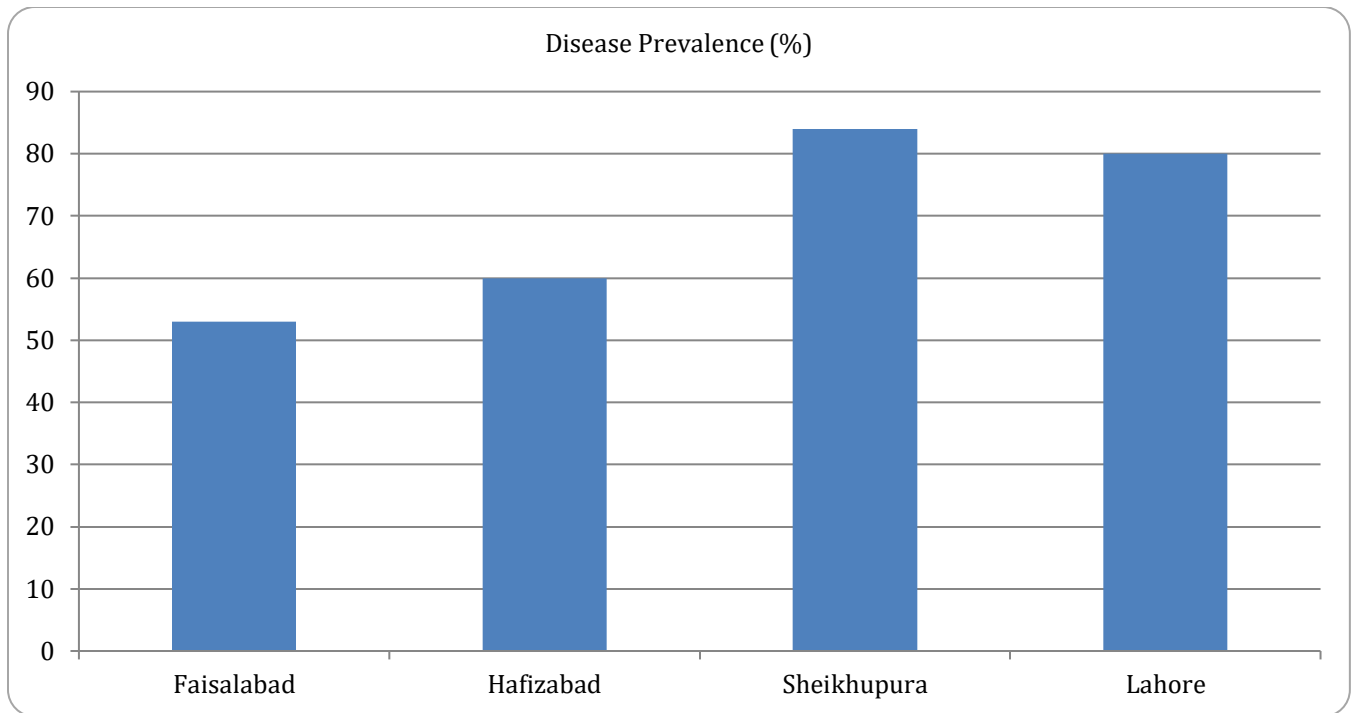


Figure 2. Graphical representation of disease prevalence in visited districts of Punjab.

Thirteen rice fields were visited in district Sheikhupura of which 11 rice fields were attacked by brown spot and disease was not present in 2 locations and pairwise mean comparison showed the maximum disease incidence at Sheikhupura Muridk road 2 in Super rice (74%) while the lowest noted

from Gujranwala road 1 (17%) in KSK-282. The highest severity of brown spot in district Sheikhupura, was observed from Gujranwala road 1 (86%) in KSK-282 while the minimum noted from the Sheikhupura Gujranwala Rd 3 (29%) in Super Basmati (Table 2).

Table 2. Disease incidence and severity of Brown spot of rice in district Sheikhupura.

Sheikhupura				
Sr. No	Location	Variety	D. I %	D. S %
1	Sheikuura Bypass	Super Basmati	55.58 A	62.57 B
2	Muhallama rajpura	Super Basmati	46.67 B	71.94 AB
3	Gujranwala Rd 1	KSK-282	17.78 E	86.87 A
4	Gujranwala Rd 2	Super rice	26.67 DE	73.64 AB
5	Gujranwala Rd 3	Super Basmati	53.33 B	29.07 C
6	Gujranwala Rd 4	Super Basmati	51.11 B	83.56 A
7	Sheikhupura Muridk Rd 1	Kainat	55.56 B	71.40 AB
8	Sheikhupura Muridk Rd 2	Super rice	74.19 A	68.69 AB
9	Sheikhupura Muridk Rd 3	Kainat	44.56 BC	71.67 AB
10	Chak no 44 Rd 1	Super Basmati	48.89 B	70.72 AB
11	Chak no 44 Rd 2	PK-386	42.22 BC	59.02 B

D.I(%)G.M 44.729 CV 17.55,D.S(%) G.M 67.741 CV 17.95

In district Lahore 15 rice growing fields was surveyed among them 12 fields were infected with disease while 3 were not affected with brown spot and the pairwise mean comparison resulted highest incidence of brown spot was observed from Chak no 44 Rd (82%) and the

minimum incidence was near the Shamke road 1 (24%) in KSK-282. In Lahore, the highest severity of disease was observed at Kot pind idass (88%) in Super rice, but the minimum observed at Shamke road 2 (46%) in PK 386 (Table 3).

Table 3. Disease incidence and severity of Brown spot of rice in district Lahore.

Lahore				
Sr. No	Location	Variety	D. I %	D. S %
1	Shamke	Super Basmati	45.00 A	61.40 CDE
2	KSK-1 Rd	Kainat	53.33 BCD	64.18 BCD
3	KSK-2 Rd	Super Basmati	64.44 AB	46.34 E
4	Chak no 45 Rd	Super Basmati	48.96 CDE	79.48 AB
5	Chak no 46 Rd	Super Basmati	55.56 BCD	69.57 BCD
6	Chak no 44 Rd	KSK-282	82.00 A	54.61 DE
7	Dhamkichak 47	Super Basmati	44.44 DE	77.34 ABC
8	Shamke Rd 1	KSK-282	24.74 F	78.15 ABC
9	Shamke Rd 2	PK-386	57.78 BC	46.05 E
10	Shamke minor	Super Basmati	46.67 CDE	76.37 ABC
11	Kotpindidass	Super rice	62.00 AB	88.49 A
12	Alipur	KSK-282	40.00 E	69.15 BCD

D.I(%) G.M 50.741 CV 13.50,D.S(%)G.M 67.593 CV 15.47

In district Hafizabad brown spot disease was observed in 17 fields whereas disease was not present in 11 fields and the pairwise mean comparison showed the highest disease incidence at Gajranwali (60%) in Super Basmati, the lowest incidence calculated from Rattian in Super rice (26%). In district Hafizabad the highest severity of disease was calculated from Nawabchowkhafizabad (83%) in Kainat and minimum calculated from PSO Wazirabad Rd (30%) in Super Basmat (Table 4).

Table 4. Disease incidence and severity of Brown spot of rice in district Hafizabad.

Hafizabad				
Sr. No	Location	Variety	D. I %	D. S %
1	Tiba shah behlol	PK-386	51.11 ABC	57.05 CDE
2	PindiBhattian	Super Basmati	34.33 DE	65.53 BCD
3	Chiniotpindibhattian road	PK-386	55.56 AB	48.94 CDEFG
4	PindiBhattian interchange	Super Basmati	41.44 BCD	54.87 CDEF
5	Muzafarnoutarar	Super Basmati	58.20 ABC	80.59 AB
6	Gajranwali	Super Basmati	60.00 A	55.78 CDEF
7	Wazirabad Rd	Kainat	50.00 A	45.74 DEFG
8	Hafizabadvinekatarar Rd	Super rice	48.89 ABC	70.19 ABC
9	Vinekatarar Rd	Super Basmati	55.56 AB	35.08 FG
10	PSO Wazirabad Rd	Super Basmati	37.78 CDE	30.14 G
11	Hafizabad bypass	Super rice	53.33 AB	67.07 ABCD
12	Nawabchowkhafizabad	Kainat	49.44 BCD	83.48 A
13	Sukheke	Super Basmati	37.50 DE	63.53 BCDE
14	Rattian	Super rice	26.89 E	55.23 CDEF
15	KhunaBhattian	Super Basmati	48.89 ABC	42.79 EFG
16	Jalal purBhattian Rd	Kainat	55.56 AB	59.07 BCDE
17	JalalpurBhattian	Super rice	47.65 ABC	67.93 ABC

D.I(%)G.M 47.512 CV18.17,D.S(%) G.M 58.060 CV 22.51

41 locations of rice field were surveyed in district Faisalabad, among them 22 were attacked with brown spot disease and disease was not present on 19 sites and pairwise mean comparison showed the highest disease incidence at Chak 75 RB (71%) while the lowest incidence was (31%) at Chak 447 Kanbanwalain Super Basmati. The highest disease severity was observed in Faisalabad at Gloria restaurant and marriage hall (87%) in PK-386. Conflicting to this, minimum severity was observed at Chak 123 GB (28%) in Super rice (Table 5).

Table 5. Disease incidence and severity of Brown spot of rice in district Faisalabad.

Faisalabad				
Sr. No	Location	Variety	D. I %	D. S %
1	Chak 131 JB chukhian	Super Basmati	40.00 CD	70.69 CDE
2	Chak 57 JB Khialakalan	Super Basmati	46.67 BCD	74.79 ABCD
3	Chak 269 RB panda	PK-386	53.33 ABCD	71.94 BCD
4	Chak 372 GB kartakpur	Super Basmati	48.89 ABCD	70.79 CDE
5	Kamal food industry	Super Basmati	51.11 ABCD	46.34 G
6	Chak 447 Kanbanwala	Super Basmati	31.11 D	69.57 CDE
7	Chak 448 GB lisharan	Kainat	35.56 CD	52.24 FG
8	Chak 401 GB gandaswala	Super rice	46.67 BCD	77.34 ABCD
9	Tandliawala tehsil	Kainat	55.56 ABC	55.78 EFG
10	Kotahmad khan 1	Super Basmati	44.78 BCD	44.78 G
11	Kotahmad khan 2	Super rice	46.00 BCD	65.43 DEF
12	Chak 173 GB link	Kainat	40.55 CD	86.40 AB
13	Chak 123 GB	Super rice	42.22 BCD	28.43 H
14	AddaAwagat 1	Super rice	48.18 BCD	84.15 ABC
15	AddaAwagat 2	PK-386	42.44 BCD	81.66 ABC
16	Makkuana	Kainat	64.12 AB	75.05 ABCD
17	Arshad textile mills	Super rice	49.72 BCD	78.48 A
18	Gloria restaurant	PK-386	46.67 BCD	87.40 A
19	Chak 61 RB Bedianwala	Super Basmati	31.80 D	81.93 ABC
20	Chak 75 RB	Super Basmati	71.11 A	74.57 ABCD
21	Chak 61 RB Bedianwala	PK-386	55.56 ABC	71.31 CD
22	Chak 163 RB Blgn	Super Basmati	42.20 BCD	83.75 ABC
D.I (%) G.M 46.478 CV 29.36, D. S (%) G.M 70.060 CV 13.07				

*DI, DS, GM and CV = Disease Incidence, Disease Severity, Grand mean and coefficient of variance respectively.

DISCUSSION

The brown spot is a severe disease that damages millions of hectares in fields of rice crops in each growing period. Mechanisms of resistance against brown spot disease still need to be better result by breeders (Barnwal *et al.*, 2013). It was detected from the results that, mostly rice fields were infected with brown spot disease in all districts. The highest prevalence of brown spot disease was calculated from district Sheikhpura 84%, followed by Lahore, Hafizabad and Faisalabad with 80%, 60% and 53% respectively. Edehet *al.* (2011) reported, that the climate changes, mainly the initial favorable atmosphere plays vital role in the spread of brown spot disease. During the current survey, the highest level of disease incidence was calculated from the field of Chak 75 RB 71% in Faisalabad, Gajranwali 60% in Hafizabad, Muridkeroad 74% in Sheikhpura and at Chak no 44 Rd 82% in district Lahore. The changes in disease incidences might be due to modifications in inoculum quantity, ecological situations and traditional practices. Groth and Bond (2007) described, that the incidence and severity level of disease is dependent on quantity of inoculums, infection at growing stage, climate conditions, and resistance varieties. The highest severity of the brown spot disease was found in Lahore 88% followed by Faisalabad, Sheikhpura and

Hafizabad with 87%, 83% and 86% respectively. But the tendency of severity of disease is different than that of disease incidence. The severity of brown spot of rice in all surveyed districts of Punjab is increasing trend. The range of disease severity was highest in rainy, hotspot and highly humidity districts, which showing the large area harshly infected with brown spot disease. Rains, cloudy weather and high relative humidity are favorable environment for the development of the disease (Magar, 2015). Furthermore, these districts of Punjab are the leading Basmati rice growing regions, particularly the Super Basmati. The overview of primary varieties like Kainat, Supra, Basmati- 386 show an important role to produce inoculum at maturity stage transfer the brown spot inoculum to the Super Basmati, so it can be minimized by proper handling of rice stubbles, straw and field sanitation.

CONCLUSION

The present study concluded that Brown spot of rice is highly prevalent disease in core rice areas of Punjab. The disease prevalence was most severe in district Sheikhpura and Lahore areas. The disease incidence and severity was most observed in Super basmati and super rice varieties. The assessment of present study delivers valuable information to the rice growers by which they can use these varieties which

are resistant against the brown spot of rice disease in Punjab surveyed districts. This may increase the yield of rice growers. Therefore, for the management of brown spot of disease suitable measures should be taken and to increase the production level of rice crop. Also, advance study will be necessary to discover the effect of different varieties on disease incidence and severity level of rice brown spot under different agro-ecological areas.

REFERENCES

- Anonymous. 2016. Grain cultivation and its associated problem: overview ogghana. 2016 ASABE International Meeting.
- Anonymous. 2007. Economic Survey of Pakistan. 2006-07. Finance Division Economic Advisory Wing, Islamabad, Pakistan.
- Anwar, M. P., A. S. Juraimi, A. Man, A. Puteh, A. Selamat and M. Begum. 2010. Weed Suppressive Ability of Rice (*Oryza sativa* L.) Germplasm under Aerobic Soil Conditions. Australian Journal of Crop Science, 4: 706.
- Arshad, H., J. Khan and F. Jamil. 2008. Screening of rice germplasm against blast and brown spot diseases. Pakistan Journal of Phytopathology (Pakistan).
- Barnwal, M. K., A. Kotasthane, N. Magculia, P. K. Mukherjee, S. Savary, A. K. Sharma, H. B. Singh, U. S. Singh, A. H. Sparks, M. Variar and N. Zaidi. 2013. A review on crop losses, epidemiology and disease management of rice brown spot to identify research priorities and knowledge gaps. European Journal of Plant Pathology, 136: 443-457.
- Bashir, M. U., N. Akbar, A. Iqbal and H. Zaman. 2010. Effect of different sowing dates on yield and yield components of direct seeded coarse rice (*Oryza sativa* L). Pakistan. Journal. Agriculture. Sciences, 47: 361-365.
- Biswas, C., S. Srivastava and S. Biswas. 2010. Effect of biotic, abiotic and botanical inducers on crop growth and severity of brown spot in rice. Indian Phytopathology, 63: 187.
- Bonman, J. M. 1992. Durable resistance to rice blast disease — environmental influences. Developments in Plant Pathology. Springer Netherlands, pp. 115-123.
- Chakrabarti, N. 2001. Epidemiology and disease management of brown spot of rice in India, Major Fungal Diseases of Rice. Springer, pp. 293-306.
- Fomba, S. 1990. Rice yellow mottle virus (RYMV) on swamp rice in Guinea. International Rice Research Newsletter, 15.
- Ghoze, R., M. Ghatge and V. Subramamanyan. 1960. Rice in India (revised edition). New Delhi, India, Indian Council of Agricultural Research.
- GOP. 2014. Pakistan Economic Survey, Economic Advisor's Wing, Finance Division, Government of Pakistan, Islamabad.
- IRRI, I. 2002. Standard evaluation system for rice.: International Rice Research Institute. PO Box, 933: 1099.
- Manu, N., G. Opit, E. Osekre, F. Arthur, G. Mbata, P. Armstrong, J. Danso, S. McNeill and J. Campbell. 2019. Moisture content, insect pest infestation and mycotoxin levels of maize in markets in the northern region of Ghana. Journal of stored products research, 80: 10-20.
- Saleem, A., K. Hameed, F. F. Jamil and M. Ansar. 1999. Screening of Capsicum Germplasm Against *Phytophthora capsici*. Pakistan Journal of Biological Sciences, 2: 459-461.
- Singh, R., Sunder and R. Agarwal. 2014. Brown spot of rice: an overview. Indian Phytopath, Indian Phytopathological society.: 201-215.
- Sunder, S., R. Singh, D. Dodan and D. Mehla. 2005. Effect of different nitrogen levels on brown spot (*Drechslera oryzae*) of rice and its management through host resistance and fungicides. Plant disease research-ludihana-, 20: 111.
- Teng, P. S. and W. C. James. Disease and yield loss assessment. Plant pathologist's pocketbook. CABI, pp. 25-38.
- Yaqoob, M., R. A. Mann, S. Iqbal and M. Anwar. 2011. Reaction of rice genotypes to brown spot disease pathogen *Cochliobolus miyabeanus* under drought conditions. Mycopath journal, 9: 9-11.

Contribution of Authors:

Muhammad Jabran	:	Conduct research and manuscript write-up
Amjad Abbas	:	Design experiment and help in write-up
Ghulam Sabar	:	Help in collection of data
Ghulam Mustafa	:	Data analysis and interpretation
Muhammad Amjad Ali	:	Design experiment and help in write-up